5-1-1978

Volume 21, issue 3

Canadian Medical Association

This section provides a medium through which Canadian surgeons can declare themselves, briefly and informally, on the day-to-day affairs of surgery.

Colorectal Cancer

Carcinoma of the colon and rectum is the commonest killing cancer that afflicts Canadians. No doubt this was a major reason why the Canadian Oncology Society presented a symposium on the subject at its first annual meeting. Although, among surgeons, only those dealing with the gastrointestinal tract will encounter colorectal cancer professionally, a disease so common will unfortunately be experienced personally by many of us. Moreover, each of the six presentations which are presented in this issue contains principles about neoplastic disorders that all surgeons can be reminded of with benefit. The paper by Morson (page 206) provides glimpses of the very nature of neoplastic transformation. Miller (page 209) reminds us that there are causes, albeit poorly understood, of cancer. Gold's paper (page 212) updates the still disappointingly limited contributions of immunology to cancer control. The papers of Localio (page 214), Rider (page 215) and Klaassen (page 218) should remind us that neoplasia requires a flexible use of all treatment modalities. Until the rates of control reach more acceptable levels, there must be a willingness to use any or all of our tools in innovative ways and in proper prospective randomized trials so that therapy can be based as much as possible on fact and as little as possible on hope or belief.

To many, colorectal cancer is a mundane subject because of its commonality. Considering the enormity of the morbidity and mortality that it produces, current information about it must be kept before those physicians and surgeons treating bowel tumours, so that Canadians are not subjected to obsolete or unnecessary management. Until our control over this disease is considerably improved, the continuing education of surgeons must regularly include a review of colorectal cancer.

J.E. DEVITT, MD, M SC, FRCS(EDIN), FRCS[C]
Associate dean,
Continuing medical education,
University of Ottawa,
Ottawa, Ont.

Colorectal Cancer: Its Pathology and Immunology Revisited

The fortunes of carcinoembryonic antigen (CEA) have been fluctuating since its discovery in 1965 by Gold and Freedman. In this issue (page 212) Gold lucidly summarizes the clinical uses of the test today, after its role has been modified as a result of numerous studies. Its original promise as a specific serologic test for large-bowel cancer has not been fulfilled, although it is useful in well-defined clinical situations. In patients suspected to have cancer of the large bowel or pancreas the test may be of value if used in conjunction with clinical and other laboratory findings. But Gold emphasizes that it is not useful as a screening test. Extensive and advanced carcinomas of the large bowel produce high concentrations of circulating CEA, so the assay is of great prognostic value; low concentrations indicate a good possibility of cure following tumour resection whereas persistent high concentrations indicate a poor prognosis. The assay for CEA is of greatest value in detecting tumour recurrence as indicated by an elevation of CEA concentration following an initial fall after tumour resection. The significant role played by CEA in clinical practice is now well established, but the most important aspect of the pioneer work of Gold and his colleagues in Montreal is that it has excited and encouraged other investigators to search for more specific immunologic markers in large-bowel cancer and other malignant conditions.

Dr. Basil Morson presents (page 206) a succinct account of the state of the art concerning some aspects of the pathology of colorectal cancer. He

restates well-established facts (many of which have come from his own laboratory) and adds personal views reached as a result of extensive experience in this field. As he admits, some of these opinions result from anecdotal experiences; for instance, the natural history of many lesions is made clear only if the lesions are untreated. Thus, it must be a rare experience to detect, follow and leave untreated (because of patient refusal) benign epithelial colonic lesions and watch their gradual transformation into cancer. This type of observation means that at least some adenomas become malignant but gives no clue as to how often this occurs. Nevertheless, that it does occur establishes a vitally important fact and many would agree with Morson that the epithelial polyp is the most common immediate predisposing condition to rectocolic carcinoma. It is generally agreed that certain polyps with specific features are more likely to become malignant. The histologic type of the polyp is important. Villous lesions although far less common than tubular adenomas have a higher potential for malignant change. Larger polyps are more likely to become malignant than smaller ones and polyps that show epithelial dysplasia are more likely to behave in a malignant fashion. The propensity of the villous adenoma to malignant change may in fact be only a reflection of this epithelial atypia which is more common in these lesions. Epithelial dysplasia, however, is not an absolute determinant of ultimate invasive transformation, for it appears that regression of atypia can occur in much the same way as it happens in carcinoma in situ of the cervix. Such regression, however, must be exceptionally rare.

Despite advances in diagnostic techniques the cure rate for colorectal carcinoma has not changed substantially in the past 10 years. Even now, at the time of surgery the tumour will have spread beyond the reach of resection in about 25% of patients and we are at an impasse. If, as Morson suggests (and his viewpoint is by no means unanimous), the transformation from benign to malignant epithelial lesions is common and if most carcinomas arise from benign polyps with a long latent period in which there is an "in-situ" phase, then the position is somewhat analogous to the carcinoma in situ–invasive squamous cell carcinoma of the uterine cervix. If we also accept the old surgical aphorism that about 70% of all large-bowel carcinomas are within the reach of the proctosigmoidoscope, then perhaps it is time to consider the feasibility of a program designed to detect these lesions in symptomless patients, in much the same way as was done in British Columbia with "Pap" smears of the cervix. Obviously an appropriate community and a selected age group would have to be studied. Patient cooperation would probably be a serious problem and the cost might be too great for the federal taste, but such a program could provide answers to many of the questions regarding the life history of the polyp. At the same time a marked reduction in the incidence of large-bowel cancer might follow. Proctosigmoidoscopic examinations are now being done by individual physicians in the course of routine physical examinations, but the results are too few and are not systematically collected, preventing a knowledge of the overall outcome because the data derived from such studies are not collated or controlled.

F.M. COLE, MB, B CH, FRCP[C]

Chief of service,
Anatomic pathology,
McMaster University Medical Centre,
Hamilton, Ont.

Upper Gastrointestinal Hemorrhage

Upper gastrointestinal hemorrhage, one of the commonest causes of emergency admission to hospital, is associated with a mortality of 5% to 30% depending on the extent and site of bleeding. In over 50% of cases the hemorrhage is from a duodenal ulcer. Acute gastric erosions, due to the ingestion of ulcerogenic drugs such as alcohol and acetylsalicylic acid, have now become the second commonest cause of bleeding. Other common causes include chronic gastric ulcer and esophageal varices. In the early 1960s management of patients with upper gastrointestinal bleeding consisted of, correcting hypovolemic shock, gastric lavage with cold saline and, when the patient was stable, roentgenography of the upper gastrointestinal tract. This approach, however, was associated with a high mortality.[1] Although rigid instruments were available for endoscopy, the associated morbidity and mortality prohibited their widespread use in identifying the source of bleeding.

With the introduction and increasing use of fiberoptic endoscopes, it became apparent that endoscopy was more accurate than roentgenography in demonstrating the source of upper gastrointestinal bleeding[2-4] and that an aggressive approach—early endoscopy, establishing a diagnosis before surgery and early surgery for appropriate lesions—would decrease the mortality.[5]

Once the source of bleeding is established, what is the correct surgical approach? Addressing themselves to this problem, Dufour and Rheault in this issue of the journal (page 261) studied 68 patients with severe upper gastrointestinal bleeding who had emergency surgery. Their overall mortality of 29.5%, although high, is comparable to that of other studies.[6,7] Bleeding gastric ulcers led to a higher mortality than duodenal ulcers, because bleeding gastric ulcers generally occur in older patients and are associated with a high rate of rebleeding. The authors have also shown that vagotomy and gastrectomy will result in a significantly lower mortality than other surgical procedures. It is not clear from their article what type of surgery should be performed for individual lesions.

For bleeding duodenal ulcers, subtotal gastrectomy was for a long time favoured by many surgeons. Since

emergency gastrectomy can result in a 30% mortality,[8] surgeons have tried other procedures in which the mortality and rate of rebleeding are low. An approach to management has evolved that provides maximal reduction of acid secretion and "tailors" the operation to the age and condition of the patient. In reasonably healthy patients under 60 years of age vagotomy and antrectomy, with oversewing of the ulcer, result in mortality of less than 5%.[7] In older, ill patients vagotomy and pyloroplasty, with oversewing of the ulcer, lead to a much lower mortality than gastrectomy.[9,10]

With respect to the bleeding gastric ulcer, gastrectomy in younger patients will successfully arrest the hemorrhage and has an acceptable operative mortality. In the elderly patient conservative surgery, comprising vagotomy, pyloroplasty and oversewing of the ulcer, will give the best results.[7,11,12]

Bleeding acute gastric erosions due to the ingestion of alcohol or acetylsalicylic acid can be successfully managed by conservative means.[13] Septic induced erosions are associated with a high mortality, whether management is surgical or conservative, but prophylactic antacid therapy and control of infection (early drainage of an intra-abdominal abscess or removal of an infected central venous catheter) will reduce the number of such erosions. If bleeding persists then vagotomy and subtotal gastrectomy will stop the hemorrhage.

The reports that aggressive management and selective surgery result in low mortality and morbidity are encouraging. What is needed are well-designed randomized studies comparing different forms of therapy in patients under and over 60 years of age. Ethical controlled studies would allow us to formulate a sound approach to the management of patients with upper gastrointestinal hemorrhage.

H.S. HIMAL, MD, FRCS[C]

Associate professor,
Department of surgery,
Royal Victoria Hospital,
Montreal, PQ

References

1. HIMAL HS, WATSON WW, JONES CW, et al: The management of upper gastrointestinal hemorrhage: a multiparametric computer analysis. *Ann Surg* 179: 489, 1974
2. ALLEN HM, BLOCK MA, SCHUMAN BM: Gastroduodenal endoscopy: management of acute upper gastrointestinal hemorrhage. *Arch Surg* 106: 450, 1973
3. COTTON PB, ROSENBERG MT, WALDRAM RPL, et al: Early endoscopy of oesophagus, stomach, and duodenal bulb in patients with haematemesis and melaena. *Br Med J* 2: 505, 1973
4. KATON RM, SMITH FW: Panendoscopy in the early diagnosis of acute upper gastrointestinal bleeding. *Gastroenterology* 65: 728, 1973
5. HIMAL HS, PERRAULT C, MZABI R: Upper gastrointestinal hemorrhage: aggressive management decreases mortality. *Surgery* (in press)
6. SCHILLER KFR, TRUELOVE SC, WILLIAMS DG: Haematemesis and melaena, with special reference to factors influencing the outcome. *Br Med J* 2: 7, 1970
7. Immediate results of emergency operation for massive upper gastrointestinal hemorrhage. A cooperative study by the Connecticut Society of American Board Surgeons. *Am J Surg* 122: 387, 1971
8. FOSTER JH, HICKOK DF, DUNPHY JE: Changing concepts in the surgical treatment of massive gastroduodenal hemorrhage. *Ann Surg* 161: 968, 1965
9. BOULOS PB, HARRIS J, WYLLIE JH, et al: Conservative surgery in 100 patients with bleeding peptic ulcer. *Br J Surg* 58: 817, 1971
10. SMITH GK, FARRIS JM: Rationale of vagotomy and pyloroplasty in management of bleeding duodenal ulcer. *JAMA* 166: 878, 1958
11. DORTON HE: Vagotomy, pyloroplasty and suture for bleeding gastric ulcer. *Surg Gynecol Obstet* 122: 1015, 1966
12. KRAFT RO, MYERS J, OVERTON S, et al: Vagotomy and the gastric ulcer. *Am J Surg* 121: 122, 1971
13. HIMAL HS, WATSON WW, JONES CW, et al: The management of bleeding acute gastric erosions: the role of gastric hypothermia. *Br J Surg* 62: 221, 1975

Annular Pancreas

In this issue (page 241) Johnston describes the clinical picture of annular pancreas in neonates and adults, and correlates the clinical differences between these two groups of patients with anatomical differences in the encircling pancreas. Although clinical differences between adults and children have been noted before[1] this is the first suggestion that anatomical differences between the clinical types of annular pancreas exist. Basically Johnston contends that the patient who presents with the clinical picture of duodenal obstruction (usually a neonate but not always, as illustrated by his cases 2 and 5) has a ring of pancreatic tissue lying on the duodenal wall, but separable from the duodenum. This type of annular pancreas is drained by a main duct. The patient who has a duodenal ulcer proximal to an annular pancreas has pancreatic tissue buried in the duodenal wall, and this tissue is drained by many small ducts opening into the duodenum. An excellent example of this type of annular pancreas is the well-documented case reported by Strully, Schwartz and Nagaraj.[2]

From a practical standpoint the observations made by Johnston are unlikely to affect the treatment of annular pancreas, since some form of bypass is indicated in both types in preference to a direct attack on the ring of pancreatic tissue.[3,4] However, the observations may stimulate additions to our knowledge of the embryology of the pancreas and the entity called annular pancreas.

O.G. THURSTON, MD, FRCS[C]

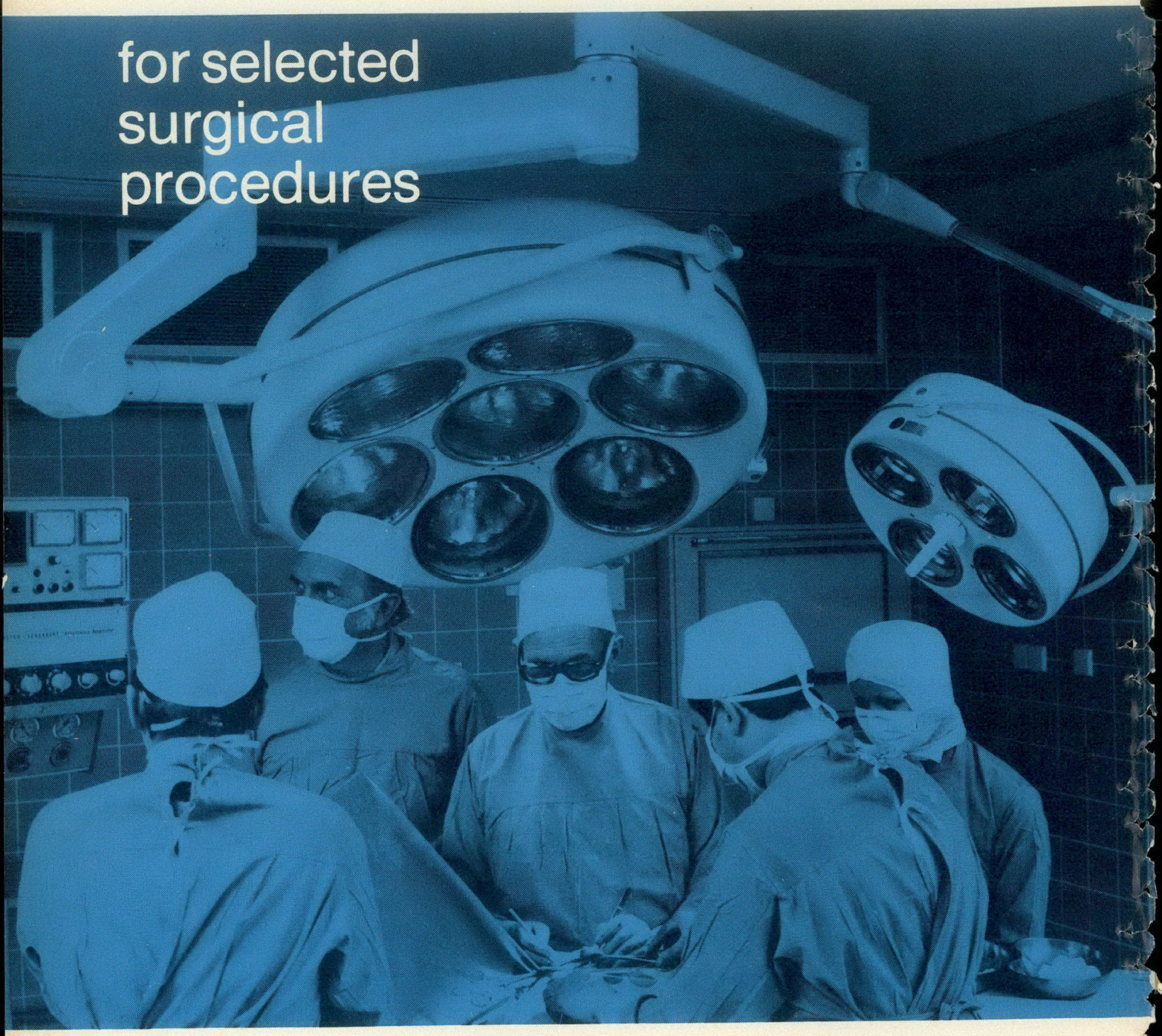
Department of surgery,
University of Alberta Hospital,
Edmonton, Alta.

References

1. THOMFORD NR, KNIGHT PR, PACE WG, et al: Annular pancreas in the adult: selection of operation. *Ann Surg* 176; 159, 1972
2. STRULLY LV, SCHWARTZ DN, NAGARAJ GS: Pancreatoduodenectomy in annular pancreas for relief of duodenal obstruction. *Am J Dig Dis* 20: 671, 1975
3. MERRILL JR, RAFFENSPERGER JG: Pediatric annular pancreas: twenty years' experience. *J Pediatr Surg* 11: 921, 1976
4. MENDELSON G, KOTZMANN RR, MCLELLAN RM, et al: Annular pancreas in an adult. *Aust NZ J Surg* 42: 278, 1973

To lower
blood pressure
during
anesthesia

for selected
surgical
procedures



Nipride*

reduces excessive
blood loss

Nipride* (sodium nitroprusside)

for controlled hypotension during anesthesia

Rx Summary

'Nipride' is only to be used as an infusion with sterile 5% dextrose in water without preservatives. Not for direct injection.

Indications

'Nipride' is indicated for producing controlled hypotension during anesthesia to reduce bleeding in surgical procedures where deemed appropriate. Benefit-risk ratio should be carefully considered on an individual basis.

Contraindications

In the treatment of compensatory hypertension, e.g. arteriovenous shunt or coarctation of the aorta. It is also contraindicated in physically poor-risk patients (A.S.A. Risk 5), in patients with uncorrected anemia or hypovolemia or in those with known inadequate cerebral circulation. In patients with liver disease, severe renal disease, Leber's optic atrophy and disease states associated with vitamin B_{12} deficiency.

Warnings

'Nipride' is only to be used as an infusion with sterile 5% dextrose in water without preservatives. Not for direct injection. Infusion rates greater than 8 μg/kg/minute are virtually never required. If at this rate an adequate reduction in blood pressure is not obtained within 10 minutes, administration of 'Nipride' should be stopped.
Fatalities due to cyanide poisoning have occurred following sodium nitroprusside administration. One factor is common to all known cases, namely that large amounts of nitroprusside were infused at high rates. Since detoxification relies upon enzymatic action, the rare possibility of deficient or atypical enzymes occurring in humans should always be considered. Patients most apt to run into difficulties are those who are resistant to the hypotensive effect or those in whom maintenance at the selected blood pressure level is difficult or impossible.
Constant attention to the patient's dose-response characteristics is mandatory. If infusion rates are in excess of 8 μg/kg/minute determine the nature of the response (effective constant response at higher dose; tachyphylactic; resistant – none or less than expected). As soon as either tachyphylaxis or resistance is determined the infusion of 'Nipride' should be discontinued immediately. In abnormal responders it has been noted that metabolic acidosis may occur at higher doses.

Caution should be exercised in using 'Nipride' in patients with hypothyroidism or severe renal impairment.
Blood levels of thiocyanate should be determined if treatment is to be extended especially in patients with severe renal dysfunction. As long as blood thiocyanate levels do not exceed 10 mg/100 ml, it is probably safe to continue with the infusion. Peritoneal dialysis can be helpful if too high levels of thiocyanate are found.
Hypertensive patients are more sensitive to the intravenous effect of sodium nitroprusside than are normotensive subjects. Patients receiving concomitant antihypertensive medications (especially hydralazine or hexamethonium) are more sensitive to the hypotensive effect of sodium nitroprusside and the dosage of 'Nipride' should be adjusted downward accordingly.
The following Warnings apply to the use of 'Nipride' for controlled hypotension during anesthesia:

1. Extreme caution should be exercised in patients who are especially poor surgical risks (A.S.A. class 4 and 4E).
2. Tolerance to blood loss, anemia and hypovolemia may be diminished. If possible, preexisting anemia and hypovolemia should be corrected prior to employing controlled hypotension.
3. Hypotensive anesthetic techniques may alter pulmonary ventilation perfusion ratio. Patients intolerant of additional dead air space at ordinary oxygen partial pressure may benefit from higher oxygen partial pressure.
4. Resistance and tachyphylaxis occur more frequently in normotensive patients infused with sodium nitroprusside. Induction of deliberate hypotension in healthy young individuals may prove to be more difficult than in other segments of the population.
5. Upon discontinuance of the sodium nitroprusside infusion for the purpose of controlled hypotension during anesthesia a rebound hypertension has been observed on rare occasions.

Usage in pregnancy

The safety of 'Nipride' in women who are or who may become pregnant has not been established; hence, it should be given only when the potential benefits have been weighed against possible hazard to mother and fetus.

Usage in children

The safety of 'Nipride' in children has not been established. Clinical experience is limited.

Precautions

Adequate facilities, equipment and personnel should be available for frequent and vigilant monitoring of blood pressure. When the infusion is slowed or stopped, blood pressure usually begins to rise immediately and returns to pretreatment levels within one to ten minutes. It should be used with caution and initially in low doses in elderly patients, since they may be more sensitive to the hypotensive effects of the drug.
If, in the clinical situation, stress induced by pain or manipulation is reduced or eliminated during 'Nipride' infusion, the patient could experience a greater than expected reduction in blood pressure unless the rate of infusion is adjusted downward as required.
'Nipride' tends to deteriorate in the presence of light. Therefore, the infusion bottle should be wrapped with aluminum foil or other opaque material. Solutions of 'Nipride' should not be kept or used longer than four hours. 'Nipride' in aqueous solution yields the nitroprusside ion, which reacts with even minute quantities of a wide variety of organic and inorganic substances to form usually highly coloured reaction products (blue, green or dark red). If this occurs, the infusion should be replaced as quickly as possible.

Adverse reactions

Nausea, retching, emesis, diaphoresis, apprehension, headache, restlessness, agitation, muscle twitching, retrosternal discomfort and chest pain, palpitations, dizziness, faintness, weakness, rash, abdominal pain, confusion and somnolence have been noted with too rapid reduction in blood pressure. These symptoms rapidly disappeared with slowing of the rate of infusion or temporary discontinuation of infusion and did not reappear with continued slower rate of administration.
Irritation of the injection site may occur. Methemoglobinemia and one case of hypothyroidism following prolonged therapy have been reported.

Dosage and administration (for controlled hypotension)

Use of 'Nipride' in anesthetized normotensive patients undergoing deliberate hypotensive surgery must be restricted to carefully selected cases. There is a possibility of an abnormal response occurring in normotensive patients. In this event, the infusion of 'Nipride' should be discontinued immediately. (See Warnings).

The contents of a 50 mg 'Nipride' vial should be dissolved in 3 ml of sterile dextrose in water without preservatives. **No other diluent should be used.** Depending on the desired concentration, all of the prepared stock solution should be diluted in 500 or 1000 ml of 5 percent sterile dextrose in water and promptly wrapped in aluminum foil or other opaque material. Both stock solution and infusion solution should be freshly prepared and any unused portion discarded. The freshly prepared solution for infusion has a very faint brownish tint. If it is highly coloured, it should be discarde ' (See Precautions). The solution should not be kept or used longer than four hours from initial reconstitution. The infusion fluid used for the administration of 'Nipride' should not be employed as a vehicle for simultaneous administration of any other drug.
'Nipride' dosage varies considerably from patient to patient, hence the need for individual titration. The infusion should be started at the lower dosage range, 0.5 μg/kg/minute and increased by 0.2 μg/kg/minute every 5 minutes until the desired reduction in blood pressure is obtained. The blood pressure usually starts to drop immediately or at least within a few minutes. Continuous monitoring of the blood pressure is necessary. Blood pressure should not be allowed to drop at too rapid a rate and systolic pressure should not be lowered below 60 mm Hg.
Infusion rates greater than 8 μg/kg/minute should rarely be used. The maximum recommended dose is 800 μg/minute.
'Nipride' should be administered by an infusion pump, micro-drip regulator or any similar device that will allow precise measurement of the flow rate. Avoid extravasation. The rate should be adjusted to maintain the desired hypotensive effect, as determined by frequent blood pressure determinations.
For the use of 'Nipride' in the treatment of hypertensive crises please refer to the Product Monograph.

Supply

'Nipride' is supplied in 5 ml amber-coloured vials containing the equivalent of 50 mg sodium nitroprusside for dilution with 5 percent sterile dextrose in water (available in packages of 10).

Product Monograph available on request.

* Reg. Trade Mark for sodium nitroprusside 'Roche'
®Reg. Trade Mark

Can. 8042

ROCHE®
Hoffmann-La Roche Limited
Vaudreuil, Québec
J7V 6B3

PAAB
CCPP

REVIEW ARTICLE

Clinical Value of Gastrointestinal Fiberoptic Endoscopy

A. GROLL, MB, CH B, MRCP(LOND), FRCP[C]

This review describes the contribution of fiberoptic endoscopy and its associated ancillary procedures to the improved diagnosis of some common gastrointestinal disorders. The diagnostic approach to esophagitis and carcinoma of the esophagus and stomach is outlined. Swallowed foreign bodies that do not pass out of the stomach can be removed with relative ease by endoscopic ancillary procedures. The role of endoscopy in duodenal ulcer disease and the effects on morbidity and mortality of the vigorous diagnostic approach in upper gastrointestinal hemorrhage are discussed. Endoscopy is invaluable for assessing the condition of the stomach postoperatively.

Colonoscopic polypectomy has lent support to the "polyp–cancer" hypothesis. The role of colonoscopy in the evaluation of inflammatory bowel disease must still be delineated.

Endoscopic retrograde cholangiopancreatography is of value in the investigation of obstructive jaundice and pancreatic disease. In the former, noninvasive techniques of ultrasonography and computerized tomography scanning complemented by fine-needle transhepatic cholangiography will probably be the preferred methods of investigation.

The impact of the contribution of fiberoptic endoscopy on health care will be maintained only if the physician has been properly trained in its use and has an understanding of the different diseases.

Cette revue fait part de la contribution de la fibroscopie et des interventions associées qui en découlent, à l'amélioration du diagnostic de quelques affections gastrointestinales courantes. On décrit la technique de diagnostic utilisée dans l'oesophagite et le carcinome de l'oesophage et de l'estomac. Les corps étrangers ingérés qui ne sont pas évacués de l'estomac peuvent être retirés avec une facilité relative grâce à une technique s'appuyant sur l'endoscopie. On discute du rôle de l'endoscopie dans l'ulcère duodénal et des effets d'un abord diagnostique vigoureux sur la morbidité et la mortalité associées à l'hémorragie gastrointestinale haute. L'endoscopie est de plus précieuse pour l'évaluation de l'estomac dans la période postopératoire.

La polypectomie au colonoscope a apporté des arguments en faveur de l'hypothèse reliant polype et cancer. Le rôle de la colonoscopie dans l'évaluation des maladies inflammatoires intestinales reste à être précisé.

La cholangiopancréatographie endoscopique rétrograde n'est d'aucune utilité pour l'étude de l'ictère par rétention et des maladies du pancréas. Dans le premier cas, des techniques douces telles que les ultrasons et la tomographie sur ordinateur assistés par la cholangiographie transhépatique à l'aiguille fine sera probablement la méthode d'investigation préférée.

La contribution de la fibroscopie aux soins de santé ne pourra se maintenir que si le médecin reçoit une formation satisfaisante sur l'utilisation de cette technique et qu'il possède une compréhension des différentes maladies.

From the division of gastroenterology, department of medicine, Queen's University and Kingston General Hospital, Kingston, Ont.

Reprint requests to: Dr. A. Groll, Division of gastroenterology, Queen's University, 102 Stuart St., Kingston, Ont. K7L 2V6

Since the introduction of fiberoptics in 1958[1] technologic advances in endoscopy have permitted the direct scrutiny of an ever-increasing area of the gastrointestinal tract. It is now possible to examine the upper gastrointestinal tract as far as the fourth part of the duodenum, and skilfully performed colonoscopy will permit the examination of the whole colon. Enteroscopy of the entire small bowel[2] is expected to be feasible in the future. The endoscope makes possible a range of procedures including accurate target biopsies, cannulation of the papilla of Vater, snare-cauterization of polyps and removal of foreign bodies. The latest achievements are endoscopic sphincterotomy of the papilla of Vater and the extraction of gallstones from the common bile duct.[3-5] Research is being conducted into argon laser systems[6,7] for gastrointestinal bleeding.

These advances have occurred rapidly and at times appear to have turned the physician from a diagnostician into a technician. A correct diagnosis can be reached only after a critical analysis of the clinical problem and careful interpretation of the endoscopic observations.

Esophageal Disorders

Flexible fiberoscopes, because of their ease of passage and excellent optical systems, have almost completely replaced the rigid metal esophagoscopes. Patients tolerate the procedure, performed under local anesthesia and sedation, extremely well. The endoscopist can examine the mucosa in detail, easily identify the gastroesophageal mucosal junction and observe, to some extent, the nature of esophageal peristalsis.

A convincing clinical problem is esophageal acid reflux; when there is a commencing and recurrent history of this condition it must be fully investigated and the patient not simply advised to take antacids. Obviously dysphagia as the sole symptom is a mandatory indication for endoscopy. Barium esophagography remains an insensitive means for the diagnosis of early esophageal ulceration and inflammation. The clinical decision whether to treat a patient with reflux conservatively or surgically will be influenced by the degree of inflammation seen at endoscopy. The presence of even a slight stricture, not appreciable on a roentgenogram, would favour a surgical approach. However, endoscopy alone is not completely reliable as a guide, since the mucosa in the study by Ismail-Beigi, Horton and Pope[8] showed no macroscopic evidence of esophagitis in approximately 20% of patients with se-

rious acid-reflux symptoms and positive esophageal acid-perfusion tests. Esophageal biopsy showed evidence of esophagitis in nearly all these patients, confirming that biopsy is a more sensitive method of examination of the esophageal mucosa than endoscopy. We agree with Ismail-Beigi and colleagues who claim to have had no success in making a diagnosis of early esophagitis from the small biopsies obtained through the fiberoscope, since these do not usually contain lamina propria. Their criteria for the histologic diagnosis of esophagitis were established from biopsies done with the multipurpose Rubin tube,[8] which enabled them to define the distribution of the histologic changes of gastroesophageal reflux in the distal esophagus.[9] The Rubin tube can be passed along the side of the endoscope permitting multiple biopsies to be taken under direct vision, or a fairly accurate measurement may be made during endoscopy as to where the tube should be placed. Such biopsies should be undertaken in all patients with reflux when the mucosa appears normal or when the endoscopic interpretation of esophageal inflammation is questionable. In patients with a histologically normal mucosa the decision to perform antireflux surgery must only be taken in select patients after careful documentation of actual reflux by pH electrode methods, after obtaining evidence from acid-perfusion tests that the symptoms are arising from the esophagus, and after careful exclusion of peptic ulcer and biliary tract disease.

In the case of esophageal narrowings, ulcerations, or filling defects detected roentgenographically, an accurate diagnosis can be made by the combined use of endoscopically directed target biopsies and brush cytology. The instrument incorporates a mechanism by which the distal tip may be actively bent through an arc of 180°, and contains a long channel through which a biopsy forceps and a nylon brush can be passed after the lesion has been brought into the centre of the visual field. By these means the histologic confirmation of cancer of the esophagus and stomach has been made possible in as many as 95% to 99% of cases in various series.[10-12] Winawer and colleagues[13] showed that brush cytology alone diagnosed 97% of esophageal cancers compared with a rate of 66% when biopsy alone was employed. When both methods were combined they attained 100% diagnostic accuracy. It should be emphasized, however, that submucosal infiltrative adenocarcinoma of the esophagus still eludes diagnosis by endoscopic biopsies that are often too shallow and do not usually contain submucosa. Flexible fiberoscopes have facilitated the diagnosis of carcinoma of the cardia and fundus of the stomach because of the relative ease with which these areas can be viewed and lesions biopsied. When biopsies and cytologic examination are negative for malignant disease and the diagnosis is still suspected, biopsy using fiberoscopy can be repeated readily as it is so well tolerated by patients.

The removal of a foreign body from the esophagus or stomach can now be performed with simplicity by one of a variety of grasping forceps which can be passed through the fiberoscopes.[14-16] Until recently, foreign objects such as open safety-pins and hairpins, sewing needles and coins could be removed from the stomach only by surgery. Pediatric endoscopes[17] have obviated the need for surgery in children who have swallowed objects that cannot traverse the pylorus.

Recently Kodsi and coworkers[18] have called attention to *Candida* esophagitis as a cause of dysphagia and odynophagia. Infection may occur in individuals without any predisposing illnesses. The most accurate diagnostic criteria are the white mucosal plaques seen on endoscopy and the yeast organisms seen on microscopic examination of a direct smear from the plaques; elevated serum agglutinin titres are also found. Patients with reflux esophagitis do not have positive smears for *Candida*. In contrast, cultures are positive in both reflux and *Candida* esophagitis and therefore do not distinguish these conditions.

Gastric Disorders

The distinction of malignant from benign ulcers is obviously essential. The roentgenographic appearance of an ulcer cannot exclude malignant disease completely and significant healing may even occur in malignant gastric ulcers.[19] Every chronic gastric ulcer identified by roentgenography should be examined by fiberoscopy, target biopsies should be taken and brush cytology smears should be made. These combined procedures have achieved a 95% or higher accuracy rate in distinguishing benign from malignant ulcers.[20] Complete healing of an ulcer should be confirmed by endoscopy and its benign nature established by target biopsies and brush cytology. The rate of healing of large gastric ulcers should be determined by repeated roentgenography. If no healing has occurred by the end of 6 weeks, then repeat endoscopy must be undertaken. There is no correlation between the number of biopsies taken and the accuracy of the diagnosis of early cancer.[11,12] More important than the number is the careful selection of the biopsy sites and the accurate application of the biopsy forceps. Areas of discolouration and nodularity should be chosen, not those that are covered by apparently normal mucosa. If an ulcer is present, biopsies should be taken from the inner edge of its margin.

Endoscopic examination of the stomach postoperatively has overcome the deficiencies and limitations of roentgenography in this group of patients. The flexible fiberoscope with its remarkably maneuverable optic systems permits, in most patients, clear visualization of pyloroplasty deformities, gastroenterostomy stomas and the efferent and afferent loops. Between 10% and 30% of patients who have had gastric surgery for peptic ulcer will suffer from appreciable symptoms.[21,22] Hirschowitz and Luketic[23] described a large series of 580 postgastrectomy patients in whom 123 jejunal and marginal and 11 gastric ulcers were found; two thirds of these were undetected by roentgenography. Other diagnoses included inflammation at the anastomosis, extrusion of nonabsorbable sutures at the stoma and double-barrelled stomas.

Clinical judgement determines the number of endoscopies that should be undertaken in the presence of "dyspepsia" and normal results from barium meal studies. There is a large overlap in symptomatology in most gastrointestinal diseases and therefore, on occasion, patients alleged to have the irritable bowel syndrome are found later to have malignant disease, or peptic ulcer or inflammatory bowel disease. Patients with a reliable history of a pain–food relationship, night pain, anemia, or weight loss must be fully investigated. Another group who present with constant pain throughout the day for months, have excellent appetites, lose no weight and do not experience any night pain, do not require endoscopy. Schuman[24] studied 843 normal roentgenograms and found that 13% of the patients had lesions on subsequent gastroscopy; these included 59 gastric ulcers and 4 cancers. However, the 13% incidence is inflated as it includes 28 patients with erosive gastritis and 51 with chronic gastritis, pathologic conditions that do not show up on the roentgenogram. Furthermore, there was a poor correlation between "dyspepsia" and gastritis.

A radiologic report of any deformity or suspicious abnormality must be checked by endoscopy. A common problem is the roentgenographic interpretation of thickened gastric folds along the greater curvature of the stomach. Endoscopy will usually elucidate the problem when the gastric folds can be flattened by air insufflation and multiple biopsies of the mucosa are examined.

Endoscopy plays an important role

in the investigation of acute upper gastrointestinal hemorrhage. Several studies have indicated the accuracy of endoscopy compared with that of barium meal studies in identifying the bleeding site.[25-27] In a recent paper Eastwood[28] correctly asked whether the superior diagnostic accuracy of endoscopy confers any therapeutic advantage that will ultimately lead to reduced morbidity and improved survival. He presented evidence from four prospective controlled studies that emergency endoscopy has had no effect on either of these objectives. He further questioned whether the necessity of a definite diagnosis before undertaking therapy for active upper gastrointestinal bleeding has been proven and whether endoscopy may be harmful in some patients. Emergency endoscopy for acute gastrointestinal bleeding has led to a better understanding of the natural history of erosive gastritis[29] and Mallory–Weiss tears[30] and to the recognition that 15% to 40% of patients with esophageal varices bleed from nonvariceal sources.[31]

Duodenal Ulcer Disease

The role of endoscopy in the management of patients with duodenal ulcer disease is limited but extremely valuable. If the clinical response to medical therapy is not prompt and lasting in a patient alleged to have an ulcer on a roentgenogram, endoscopy is mandatory to establish its presence and to exclude other conditions. A scarred duodenal bulb without evidence of a crater is often interpreted as indirect evidence of the presence of an active ulcer in a patient with dyspeptic symptoms. Again, a lack of prompt relief of pain with antacids in such a patient warrants endoscopy. Normal findings on examination in such patients should lead to a re-evaluation of the clinical problem. When intractable pain occurs in patients with known duodenal ulcer disease, surgery should be undertaken only in the presence of an unequivocal ulcer on barium meal or endoscopy. Endoscopy has no role in the usual follow-up of asymptomatic and uncomplicated ulcers. But a complication such as pyloric stenosis occurring in patients with known duodenal ulcer disease should be evaluated by endoscopy to exclude a malignant condition.

Duodenoscopy is more accurate than roentgenography in determining the presence of duodenal ulcers and most series show an incidence between 15% and 20% where barium studies have given normal results.[32-34] This figure excludes patients in whom a diagnosis of "duodenitis" is made. The onus falls on the clinician to identify which patients with "dyspepsia" and a normal barium meal require duodenoscopy.

Duodenoscopy has led to a better understanding of the natural course of duodenal ulcer disease. The appreciation that ulcers can persist for weeks after the disappearance of symptoms and long after medical treatment has ceased may explain the tendency to frequent relapses in some patients. It has also revolutionized the approach to clinical studies of ulcer healing in response to new drugs.[35]

Colonic Disorders

It is now 7 years since the introduction of colonoscopy to clinical practice.[36-38] It remains a relatively difficult procedure requiring special techniques and skills.[39,40] A major achievement resulting from its use is the diagnosis and removal of colonic polyps,[41-43] but colonoscopic polypectomy is not without risk. In a 1974 survey[25,44] 25 298 colonoscopies were reported with a morbidity of 0.32% and a mortality of 0.008%. The most common complication of a diagnostic colonoscopy was perforation (55 cases), which was associated with the only two fatalities. There were 6214 polypectomies with a morbidity of 2.3% and no mortality. The most common complication of polypectomy was hemorrhage (1.9%). The results of colonoscopic polypectomy compare favourably with those of surgical polypectomy. The majority of pedunculated polyps can be easily removed, but special skill is required for the removal of large sessile polyps.[45]

Colonoscopic polypectomy has led to a better understanding of colonic cancer. Evidence is mounting that most, if not all, colonic cancers originate in neoplastic polyps, the "polyp–cancer sequence".[46] The criteria for malignancy in a polyp remain undecided, but most workers agree that only when definite invasion of the muscularis mucosae is present should the lesion be regarded as "clinically" malignant.[47-49] Using these criteria, Wolff and Shinya[43] found invasive carcinoma in 4.5% of 2800 polyps. If atypia and carcinoma in situ were included the overall figure for malignant change rose to 10.5%. Colonoscopic polypectomy therefore provides benefit by removing polyps with invasive carcinoma. It is obviously essential to examine all excised polyps histologically to detect invasive carcinoma in the stalk across the line of the muscularis mucosae.

Unnecessary colonoscopies to search for polyps can be avoided if detailed attention is paid to the technique of the barium enema studies. The Mälmo technique accurately detects 98% of polyps over 1 cm in diameter and 78% of polyps 1 cm and under.[42]

Colonoscopy is indicated for reaching a diagnosis when abnormal areas are shown by a barium enema and even when the barium enema result is normal in the presence of unexplained rectal bleeding, diarrhea and abdominal pain. Colonoscopy has a role to play in some cases of inflammatory bowel disease and in the examination of anastomoses, colostomies and ileostomies. In 75 patients with rectal bleeding, in whom the barium enema finding was normal, Teague, Salmon and Read[50] found 14 carcinomas, but this high incidence would have been lowered had double-contrast barium enemas been performed routinely.

The exact role of colonoscopy in the diagnosis and management of chronic inflammatory bowel disease has yet to be delineated. Tawile, Priest and Schuman[51] point out that the procedure makes it possible to evaluate the extent and activity of inflammatory bowel disease and increases the accuracy of prognosis. I would question this conclusion, as in most patients with Crohn's disease or ulcerative colitis the clinical picture, excellent roentgenograms and laboratory studies will accurately measure the activity and extent of the disease. In another study[52] colonoscopy proved to be superior to roentgenography in defining mucosal abnormalities such as ulcerations and nodular or polypoid lesions and in recognizing the segmental distribution of the disease; granulomas were found in 26% of patients when biopsies were taken from the edge of ulcers. Waye[53] observed that colonoscopy is of value when stricture and filling defects are seen on the roentgenogram following a barium enema. He recommended colonoscopy in granulomatous colitis when surgery is contemplated for providing an accurate evaluation of the extent of the disease.

Colonoscopy has an important role in ulcerative colitis. In patients with frank proctitis when the barium enema finding is normal, colonoscopy and biopsy may reveal whether the disease extends to the transverse or ascending colon (as it may do),[54,55] or is confined to the rectum (when the prognosis and natural course of the disease may be entirely different).

Colonoscopy and biopsy are called for in patients in whom uncertainty exists as to the type of inflammatory bowel disease present, since therapeutic considerations differ in ulcerative colitis and Crohn's disease. In a small group of patients in whom roentgenography shows an isolated segmental lesion, colonoscopy has been helpful in confirming Crohn's disease.

Should patients with total colitis undergo annual colonoscopic examination with biopsies and cytology studies in an attempt to identify a significant number of curable carcinomas in chronic ulcerative colitis? Morson and Pang[56]

noted that in patients with colitis in whom colonic carcinoma had already developed, rectal biopsy usually showed epithelial dysplasia. Cook, Path and Goligher,[57] however, have shown that epithelial dysplasia may be found in resected colons without carcinoma and that the epithelial changes in the rectum may be patchy or absent. Even so, the epithelial changes may indicate a special predisposition to the development of a malignant growth in the future. A number of biopsies from different parts of the colon obtainable by colonoscopy could detect those patients with epithelial hyperplasia so that they can be kept under special scrutiny for the possible development of carcinoma.

Biliary and Pancreatic Disease

The recent advance of endoscopic retrograde cholangiopancreatography (ERCP) has made a major contribution to the investigation of jaundice and proven or suspected pancreatic disease.[58-61] ERCP has been most valuable in patients with persistent or recurrent obstructive jaundice where it is impossible to be certain whether the cholestasis is intra- or extrahepatic. Laparotomy can be avoided in an appreciable number of such patients when a patent biliary system is found. When the liver biopsy shows an equivocal histologic picture, ERCP will accurately confirm or refute the diagnosis of obstruction. Biliary calculi, carcinoma of the bile duct, hepatic ducts and pancreas, sclerosing cholangitis and postoperative stricture have been diagnosed by ERCP. Selective cannulation of the biliary system usually presents more difficulty than does selective cannulation of the pancreatic ductal system. Because of a risk of ascending cholangitis after ERCP, patients should be given systemic antibiotics immediately after the procedure if contrast medium has entered poorly draining ducts. Antibiotics should also be given if patients with known extrahepatic obstruction undergo ERCP prior to surgery.

The use of ERCP for visualizing the bile ducts in obstructive jaundice will probably be replaced by percutaneous transhepatic cholangiography using the "skinny" Chiba needle technique. This new technique, which is simple and less expensive, has reduced the complication rate of conventional transhepatic cholangiography.[62-64] It also requires far less skill than the ERCP procedure. Elias and colleagues[65] carried out a randomized trial to compare both methods for bile-duct visualization in jaundice. In patients with extrahepatic cholestasis, percutaneous cholangiography was successful in 95% whereas ERCP succeeded in only 63%. On the other hand, in patients with intrahepatic cholestasis the figures were 25% and 76% respectively. Transhepatic cholangiography appears to be a more reliable method for demonstrating the biliary system when extrahepatic cholestasis is known to be present or is confidently suspected. Others have been able to perform transhepatic cholangiography in the presence of nondilated ducts[63] and in one series in 95.6%[64] of patients, and therefore support its use in differentiating intra- from extrahepatic cholestasis. However, if intrahepatic cholestasis is strongly suspected, ERCP is probably still the procedure of choice.

There is renewed attention to the use of grey-scale ultrasonography to distinguish intra- from extrahepatic cholestasis. This modality of investigation was initiated by Taylor and coworkers[66,67] in 1974 and at a recent symposium Goldberg and Ferruci[68] presented ultrasonography and computerized tomography scanning as the primary and most important noninvasive procedure to identify dilatation of the bile duct. Transhepatic cholangiography, in their opinion, should only be done if there is evidence of bile-duct obstruction. If the bile ducts are not dilated, liver biopsy and, if necessary, endoscopic retrograde cholangiography should be performed.

While retrograde pancreatography is easier to perform than cholangiography, the interpretation of the pancreatogram is much more difficult. Normal pancreatograms have now been analysed and measurements have been made of the main duct in the pancreatic head, body and tail, as well as the length of the duct.[69] Abnormal findings in pancreatography must take into account the study of the normal pancreatogram.

The distinction between chronic pancreatitis and pancreatic carcinoma has been carefully studied.[70-72] In carcinoma the main pancreatic duct is affected by an irregular segmental stricture or defect. There may also be complete obstruction, with the end of the main duct appearing irregular or smooth. The major findings in chronic pancreatitis are tortuosity of the main pancreatic duct and rigidity of its wall and, sometimes, bead-like dilatations or irregular or marked dilatations with partial stricture of the main pancreatic duct. In advanced pancreatitis there may be complete obstruction, but in most instances it is incomplete. The differentiation between these two conditions is even more complicated because chronic pancreatitis and carcinoma may occur together. Detailed examination of the duodenal sweep and papilla is part of the ERCP procedure and periampullary carcinoma may be diagnosed by biopsy and brush cytology.

The early diagnosis of pancreatic cancer is still a challenge. Pancreatography may well be an accurate and reliable method for diagnosing periampullary and pancreatic carcinoma, but nearly all reports describe results in the easily recognizable clinical setting of advanced carcinoma.

Chronic relapsing alcoholic pancreatitis may confront the physician with serious management problems. Persistent pain with frequent severe relapses often raises the possibility of a major duct obstruction or the presence of a pseudocyst. Contemplated surgical exploration can now be preceded by endoscopic retrograde pancreatography. A normal ductal system, while not excluding pancreatitis entirely, should discourage the surgeon from carrying out such an exploration and rather direct him to pay more attention to the alcohol problem. If a ductal stricture or pseudocyst is found, the surgeon can plan his surgical approach and not have to depend on an operative pancreatogram. Retrograde pancreatography has shown pseudocysts[73] communicating with the pancreatic duct and identified fistulas[74] between the cysts and peritoneal cavity in the presence of pancreatic ascites. Common-bile-duct obstruction by chronic pancreatitis may be clearly delineated by a combined pancreatogram and cholangiogram, which further elucidates the difficult problem of obstructive jaundice.

Complications of ERCP have been studied in 10 000 cases in the United States.[75] Failure of the procedure occurred in 30%, complications in 3% and death in 0.2%. Complications included pancreatitis, cholangitis, pancreatic sepsis, instrumental injury to the gastrointestinal tract and drug reaction. Pancreatitis was associated with injection into the pancreatic duct and sepsis with an injection into an obstructed duct of a pseudocyst. Experienced workers had a 15% incidence of complications, whereas the inexperienced had four times as many failures and twice as many complications.

Conclusion

The contribution of fiberoptic endoscopy to the management of certain gastrointestinal disorders is considerable. The impact of this technique on health care will be maintained only if physicians have been properly trained in its use. It is essential to have an understanding of the natural course of the disease states under investigation and to appreciate the indications and contraindications of endoscopic procedures. An erroneous endoscopic diagnosis will lead to inadequate or inappropriate treatment.

The easy availability of fiberoptic instruments and the relative ease with which these instruments can be inserted may lead to their misuse and abuse. The indiscriminate and incompetent use of these diagnostic techniques may become deleterious to the health of the population at risk. For these reasons the Canadian Association of Gastroenterology[76] has published guidelines on the minimal requirements for training in endoscopy.

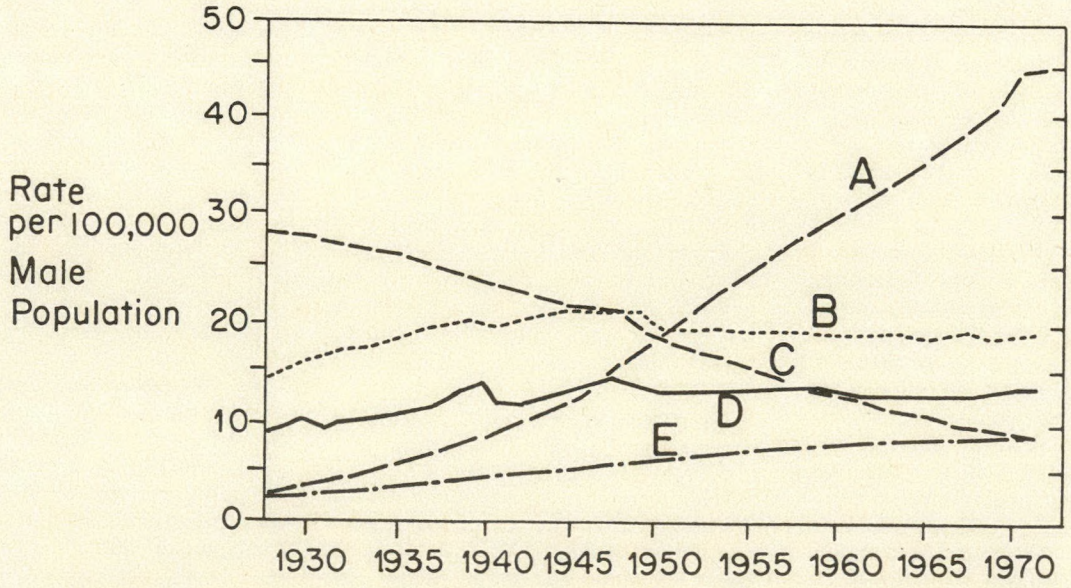
References

1. HIRSCHOWITZ BI, CURTISS LE, PETERS CW, et al: Demonstration of a new gastroscope, the fiberoscope. *Gastroenterology* 35: 50, 1958
2. OGOSCHI K, HARA Y, ASHIZAWA S: New technic for small intestinal fiberoscopy. *Gastrointest Endosc* 20: 64, 1973
3. SAFRANY L: Duodenoscopic sphincterotomy and gallstone removal. *Gastroenterology* 72: 338, 1977
4. KAWAI K, AKASAKA Y, MURAKAMI K, et al: Endoscopic sphincterotomy of the ampulla of Vater. *Gastrointest Endosc* 20: 148, 1974
5. GEENEN JE, HOGAN WJ, SHAFFER RD, et al: Endoscopic electrosurgical papillotomy and manometry in biliary tract disease. *JAMA* 237: 2075, 1977
6. SILVERSTEIN FE, AUTH DC, RUBIN CE, et al: High power argon laser treatment via standard endoscopes. I. A preliminary study of efficacy in control of experimental erosive bleeding. *Gastroenterology* 71: 558, 1976
7. WAITMAN AM, SPIRA I, CHRYSSANTHOU CP, et al: Fiberoptic-coupled argon laser in the control of experimentally produced gastric bleeding. *Gastrointest Endosc* 22: 78, 1975
8. ISMAIL-BEIGI F, HORTON PF, POPE CE 2nd: Histological consequences of gastroesophageal reflux in man. *Gastroenterology* 58: 163, 1970
9. ISMAIL-BEIGI F, POPE CE 2nd: Distribution of the histological changes of gastroesophageal reflux in the distal esophagus of man. *Gastroenterology* 66: 1109, 1974
10. PROLLA JC, KOBAYASKI S, KIRSNER JB: Gastric cancer. Some recent improvements in diagnosis based upon the Japanese experience. *Arch Intern Med* 124: 238, 1969
11. YOSHII Y, KUNO N, YAGI M, et al: Endoscopic biopsy and cytology in esophageal and gastric carcinoma with the fiberesophagoscope. *Gastrointest Endosc* 17: 150, 1971
12. KOBAYASKI S, YOSHII Y, WINANS CS, et al: Use of direct vision biopsy in the diagnosis of gastroesophageal malignancy. *Gastrointest Endosc* 18: 23, 1971
13. WINAWER SJ, SHERLOCK P, BELLADONNA JA, et al: Endoscopic brush cytology in esophageal cancer. *JAMA* 232: 1358, 1975
14. GELZAYD EA, JETLY K: Fiberendoscopy: removal of a retained sewing needle from the stomach. *Gastrointest Endosc* 18: 161, 1972
15. GRISWOLD FC, HAISLIP CE, GARDINER RJ: Removal of an intragastric foreign body using the flexible fiberoptic esophagoscope. *Gastrointest Endosc* 19: 194, 1973
16. OLSEN H, LAWRENCE W, BERNSTEIN R: Fiberendoscopic removal of foreign bodies from the upper gastrointestinal tract. A simple and consistent method using a snare. *Gastrointest Endosc* 21: 58, 1974
17. CHRISTIE DL, AMENT ME: Removal of foreign bodies from the esophagus and stomach with flexible fibreoptic panendoscopes. *Pediatrics* 57: 931, 1976
18. KODSI BE, WICKREMESINGHE PC, KOZINN PJ, et al: Candida esophagitis: a prospective study of 27 cases. *Gastroenterology* 71: 715, 1976
19. SAKITA T, OGURO Y, TAKASU S, et al: Observations on the healing of ulcerations in early gastric cancer. The life cycle of the malignant ulcers. *Gastroenterology* 60: 835, 1971
20. MORRISSEY JF: Gastrointestinal endoscopy. *Gastroenterology* 62: 1241, 1972
21. STAMMERS FAR, WILLIAMS JA: *Partial Gastrectomy*, London, Butterworths, 1963
22. GOLIGHER JC, PULVERTAFT CN, DE DOMBAL FT, et al: Five- to eight-year results of Leeds/York controlled trial in elective surgery for duodenal ulcer. *Br Med J* 2: 781, 1968
23. HIRSCHOWITZ BI, LUKETIC GC: Endoscopy in the post-gastrectomy patient. An analysis of 580 patients. *Gastrointest Endosc* 18: 27, 1971
24. SCHUMAN BM: The gastroscopic yield from the negative upper gastrointestinal series. *Gastrointest Endosc* 19: 79, 1972
25. KATON RM, SMITH FW: Panendoscopy in the early diagnosis of acute upper gastrointestinal bleeding. *Gastroenterology* 65: 728, 1973
26. SUGAWA C, WERNER MH, HAYES DF, et al: Early endoscopy: a guide to therapy for acute hemorrhage in the upper gastrointestinal tract. *Arch Surg* 107: 133, 1973
27. COTTON PB, ROSENBERG MT, WALDRUM RPL, et al: Early endoscopy of oesophagus, stomach and duodenal bulb in patients with haematemesis and malaena. *Br Med J* 2: 505, 1973
28. EASTWOOD GL: Does early endoscopy benefit the patient with active upper gastrointestinal bleeding? *Gastroenterology* 72: 737, 1977
29. KATZ D, SIEGEL HI: Erosive gastritis and acute gastrointestinal mucosal lesions, in *Progress in Gastroenterology, Vol. I*, GLASS GBS (ed), New York, Grune, 1968, p 40
30. KNAUER CM: Mallory-Weiss syndrome. Characterization of 75 Mallory-Weiss lacerations in 528 patients with upper gastrointestinal hemorrhage. *Gastroenterology* 71: 5, 1976
31. CONN HO, BRODOFF M: Emergency esophagoscopy in the diagnosis of upper gastrointestinal hemorrhage; a critical evaluation of its diagnostic accuracy. *Gastroenterology* 47: 505, 1964
32. SALMON PR, BROWN P, HTUT T, et al: Endoscopic examination of the duodenal bulb: clinical evaluation of forward- and side-viewing fibreoptic systems in 200 cases. *Gut* 13: 170, 1972
33. BLUMGART LH: Endoscopy of the upper gastrointestinal tract. *Adv Surg* 9: 97, 1975
34. NEBEL OT, FARREL PH, KIRSHNER JP, et al: Duodenoscopy in the evaluation of patients with upper gastrointestinal symptoms. *Gastrointest Endosc* 19: 142, 1973
35. GRAY GR, SMITH IS, MCKENZIE I, et al: Oral cimetidine in severe duodenal ulceration. A double-blind controlled trial. *Lancet* 1: 4, 1977
36. WOLFF WI, SHINYA H: Colonofiberoscopy. *JAMA* 217: 1509, 1971
37. DEAN ACB, SHEARMAN DJC: Clinical evaluation of a new fibreoptic colonoscope. *Lancet* 1: 550, 1970
38. DEYHLE P, DEMLING L: Colonoscopy, technique, results, indications. *Endoscopy* 3: 143, 1971
39. WILLIAMS C, TEAGUE R: Progress report on colonoscopy. *Gut* 14: 990, 1973
40. SAKAI Y: Further progress in colonoscopy. *Gastrointest Endosc* 20: 143, 1974
41. WOLFF WI, SHINYA H: Polypectomy via the fiberoptic colonoscope. Removal of neoplasms beyond the reach of the sigmoidoscope. *N Engl J Med* 288: 329, 1973
42. WILLIAMS CB, HUNT RH, LOOSE H, et al: Colonoscopy in the management of colon polyps. *Br J Surg* 61: 673, 1974
43. WOLFF WI, SHINYA H: Endoscopic polypectomy—therapeutic and clinicopathologic aspects. *Cancer* 36 (suppl): 683, 1975
44. ROGERS BH, SILVIS SE, NEBEL OT, et al: Complications of flexible fiberoptic colonoscopy and polypectomy. *Gastrointest Endosc* 22: 73, 1975
45. SHINYA H, WOLFF WI: Colonoscopic polypectomy: technique and safety. *Hosp Pract* 10: 71, 1975
46. MORSON BC: Evolution of cancer of the colon and rectum. *Cancer* 34 (suppl): 845, 1974
47. Idem: Precancerous and early malignant lesions of the large intestine. *Br J Surg* 55: 725, 1968
48. CASTLEMAN B, KRICKSTEIN HI: Do adenomatous polyps of the colon become malignant? *N Engl J Med* 267: 469, 1962
49. MORSON BC, BUSSEY HJR: Predisposing causes of intestinal cancer. *Curr Probl Surg* 1, Feb. 1970
50. TEAGUE RH, SALMON PR, READ AE: Fibreoptic examination of the colon: a review of 255 cases. *Gut* 14: 139, 1973
51. TAWILE NT, PRIEST RJ, SCHUMAN BM: Colonoscopy in inflammatory bowel disease. *Gastrointest Endosc* 22: 177, 1975
52. GEBOES K, VANTRAPPEN G: The value of colonoscopy in the diagnosis of Crohn's disease. Ibid, p 18
53. WAYE JD: The role of colonoscopy in the differential diagnosis of inflammatory bowel disease. *Gastrointest Endosc* 23: 150, 1977
54. WARWICK RR, SUMERLING MD, GILMOUR HM, et al: Colonoscopy and double contrast barium enema examination in chronic ulcerative colitis. *Am J Roentgenol* 117: 292, 1973
55. SHEARMAN DJC: Colonoscopy in ulcerative colitis. *Scand J Gastroenterol* 8: 289, 1973
56. MORSON BC, PANG LS: Rectal biopsy as an aid to cancer control in ulcerative colitis. *Gut* 8: 423, 1967
57. COOK MG, PATH MR, GOLIGHER JC: Carcinoma and epithelial dysplasia complicating ulcerative colitis. *Gastroenterology* 68: 1127, 1975
58. KASUGAI T: Recent advances in endoscopic retrograde cholangiopancreatography. *Digestion* 13: 76, 1975
59. COTTON PB: Cannulation of the papilla of Vater by endoscopy and retrograde cholangiopancreatography (ERCP). *Gut* 13: 1014, 1972
60. BLUMGART HL, SALMON PR, COTTON PB: Endoscopy and retrograde chole-

dochopancreatography in the diagnosis of the patient with jaundice. *Surg Gynecol Obstet* 138: 565, 1974
61. VENNES JA, JACOBSON JR, SILVIS SE: Endoscopic cholangiography for biliary system diagnosis. *Ann Intern Med* 80: 61, 1974
62. TSUCHIYA Y: A new safer method of percutaneous transhepatic cholangiography. *Jpn J Gastroenterol* 66: 438, 1969
63. REDEKER AG, KARVOUNTZIS GG, RICHMAN RH, et al: Percutaneous transhepatic cholangiography. An improved technique. *JAMA* 231: 386, 1975
64. PEREIRAS R JR, CHIPRUT RO, GREENWALD RA, et al: Percutaneous transhepatic cholangiography with the "skinny" needle. A rapid, simple, and accurate method in the diagnosis of cholestasis. *Ann Intern Med* 86: 562, 1977
65. ELIAS E, HAMLYN AN, JAIN S, et al: A randomized trial of percutaneous transhepatic cholangiography with the Chiba needle versus endoscopic retrograde cholangiography for bile duct visualization in jaundice. *Gastroenterology* 71: 439, 1976
66. TAYLOR KJW, CARPENTER DA: Grey-scale ultrasonography in the investigation of obstructive jaundice. *Lancet* 2: 586, 1974
67. TAYLOR KJ, CARPENTER DA, MCCREADY VR: Ultrasound and scintigraphy in the differential diagnosis of obstructive jaundice. *J Clin Ultrasound* 2: 105, 1974
68. GOLDBERG HI, FERRUCI JT: Clinical symposium: techniques to diagnose biliary obstruction. Presented at the annual meeting of the American Gastroenterological Association, Toronto, Ont., May 21-26, 1977
69. SIVAK MV JR, SULLIVAN BH JR: Endoscopic retrograde pancreatography: analysis of the normal pancreatogram. *Am J Dig Dis* 21: 263, 1976
70. BLUMGART LH: Duodenoscopy and endoscopic retrograde choledochopancreatography: present position in relation to periampullary and pancreatic carcinoma. *J Surg Oncol* 7: 107, 1975
71. FREENY PC, BILBAO MK, KATON RM: 'Blind' evaluation of endoscopic retrograde cholangiopancreatography (ERCP) in the diagnosis of pancreatic carcinoma: the 'double duct' and other signs. *Radiology* 119: 271, 1976
72. ROHRMANN CA JR, SILVIS SE, VENNES JA: The significance of pancreatic ductal obstruction in differential diagnosis of the abnormal endoscopic retrograde pancreatogram. *Radiology* 121: 311, 1976
73. SILVIS SE, VENNES JA, ROHRMANN CA: Endoscopic pancreatography in the evaluation of patients with suspected pancreatic pseudocysts. *Am J Gastroenterol* 61: 452, 1974
74. SANKARAN S, WALT AJ: Pancreatic ascites: recognition and management. *Arch Surg* 111: 430, 1976
75. BILBAO MK, DOTTER CT, LEE TG, et al: Complications of endoscopic retrograde cholangiopancreatography (ERCP). A study of 10,000 cases. *Gastroenterology* 70: 314, 1976
76. GILLIES RR, PEREY B, BECK IT: Gastrointestinal endoscopy—boon or beast? *Can Med Assoc J* 114: 589, 1976

SESAP II Question

Items 456-458



The drawing above shows the death rates per 100,000 population for cancers occurring frequently in males in the United States from 1930 to 1969. For each of the sites of primary tumors numbered below, select the appropriate curve (A,B,C,D,E) on the graph.

456. Lung

457. Colon and rectum

458. Stomach

For the critique of Items 456-458 see page 269 of this issue.

(Reproduced by permission of the American College of Surgeons from *SESAP II Syllabus: Surgical Education and Self-assessment Program No. 2*. For enrolment in the Surgical Education and Self-assessment Program No. 2 please apply to the American College of Surgeons, 55 East Erie St., Chicago, IL 60611.)

Symposium on Colorectal Cancer
1. Pathology of Colorectal Cancer

B.C. MORSON, DM, FRC PATH*

Most colorectal cancers arise from pre-existing adenomas (the adenoma–carcinoma sequence). The histology, cytology and malignant potential of the adenoma group of tumours are described. From a study of the life history of the adenoma–carcinoma sequence in cases of both familial polyposis and isolated adenoma it would appear that most colorectal cancers evolve over a long period.
The adenoma is important as a marker for increased risk of colorectal cancer, in clinical practice and in epidemiologic studies. Local excision for carefully selected early colorectal cancers is justified on the basis of the results of a long-term prospective study.

La plupart des cancers colorectaux prennent naissance à partir d'adénomes préexistants (la séquence adénome–carcinome). On décrit l'histologie, la cytologie et le potentiel de malignité des tumeurs du groupe des adénomes. De l'étude du développement de la séquence adénome–carcinome dans les cas de polypose familiale et d'adénomes isolés, il semble que la plupart des cancers colorectaux évoluent sur une longue période. L'adénome est important comme marqueur d'un risque accru de cancer colorectal, aussi bien en clinique que pour les études épidémiologiques. Si l'on s'appuie sur les résultats d'une étude prospective à long terme, l'excision locale dans les cancers colorectaux précoces bien choisis est justifiée.

This review will concentrate on two aspects of the pathology of large-bowel cancer. First, the role of polyps as precancerous lesions will be considered and how knowledge of their pathology can help in the design of cancer prevention programs. (Precancer defines a situation in which the risk of cancer is substantially increased but is not inevitable.) Second, the pathology of early colorectal cancer, and how knowledge of this can help in the choice of treatment, will be discussed. The expression early is used not in the histogenetic sense but with reference to curability.

The Relation of Large-Bowel Polyps to Cancer of the Colorectum

The evidence in favour of the adenoma–carcinoma sequence is now so overwhelming that this sequence must be considered as the major predisposing situation for large-bowel malignancy.[1,2] For pathologists the word polyp has only clinical meaning and "polyps" that result from neoplastic overgrowth of epithelium we call adenomas. The clinical condition of familial polyposis in which the large bowel is covered with thousands of adenomas might better be called familial adenomatosis. None of the other histologic varieties of polyp in the large bowel have any important contribution to make to the totality of large-bowel cancer.

The adenoma group of polyps can be subclassified in two ways: according to their histology or tissue architecture and by their cellular or cytologic characteristics.[3]

Histology

The adenoma group of polyps presents a spectrum of tissue architecture. At one end of the scale is the tubular adenoma (adenomatous polyp) which histologically shows a tubular type of proliferation, and at the other end is the villous adenoma (villous papilloma). There is a sizeable group of tumours that have an intermediate or mixed pattern and occupy a position between these two extremes. The American terminology for this group is villoglandular adenoma; this and the old term papillary adenoma should be replaced by tubulovillous adenoma.

Cytology

All adenomas have identical cytologic characteristics. This justifies their consideration as one disease. These cytologic characteristics are called epithelial dysplasia or atypia as when they develop in other epithelial surfaces. They are fundamentally no different from those seen in the cervix.

The Malignant Potential of the Adenoma Group of Tumours

The tubular adenoma (or adenomatous polyp) is the most common histologic type. The villous adenoma is much less common, while the tubulovillous type occupies a position in regard to frequency midway between these two.

The potential of the tubular adenoma for malignant change is low while that of the villous adenoma is much higher.[4] The malignant potential of the intermediate type with a villous component

Presented at the Canadian Oncology Society symposium on colorectal cancer, held at the annual meeting of the Royal College of Physicians and Surgeons of Canada, Toronto, Ont., Jan. 27, 1977

W.G. Cosbie Memorial Lecture, sponsored by the Ontario Cancer Foundation

**Consultant pathologist and director, research department, St. Mark's Hospital, London, UK*

Reprint requests to: Dr. B.C. Morson, Director, Research department, St. Mark's Hospital, City Road, London EC1V 2PS, UK

more closely approaches that of the pure villous adenoma than that of the pure tubular adenoma. These estimates were produced before the days of colonoscopy, which has resulted in an increase in the number of adenomas seen per patient. But if only 2% of adenomas became malignant during the average life span of an individual of the Western world, this would probably be enough to account for the prevalence of colorectal cancer in the general population.

The potential of an adenoma for malignant change increases with the degree of epithelial dysplasia. Severe epithelial dysplasia is much more common in villous tumours than in the pure tubular adenomas. This, of course, is in accord with the greater malignant potential associated with "villosity". Most accounts regard dysplasia as a progressive epithelial process, but this progression, as in the cervix, is not inevitable. Indeed, we have very little information about the risk of mild dysplasia becoming moderate or severe dysplasia; in the colon the latter is equated with carcinoma in situ. In situ carcinoma of the cervix may remain stationary for many years and may even regress. The same is probably true for severe dysplasia in association with colon adenomas.

Tumours under 1 cm in diameter have a low potential for malignant change. As their size increases, so does the malignant potential. The critical size seems to be 2 cm. Thus, as adenomas grow large, so the risk of cancer increases. But even when their diameter exceeds 2 cm the development of cancer is not inevitable, although the risk of such development is high. What makes adenomas grow and what makes them regress? Presumably there are environmental influences affecting their capacity to grow.

An uncontrolled clinical study comparing adenomas in Japan where there is a low prevalence of colorectal cancer, with adenomas in England, where prevalence is relatively high, showed that Japanese adenomas on average were much smaller than adenomas in England.[5] It appears that adenomas in Japan seldom grow to the same size as English adenomas.

Moreover, the frequency of adenomas in Japan, particularly of the pure villous type, is low. In addition, severe dysplasia in adenomas is by and large more common in England than in Japan.

Other such studies have found that in areas where the frequency of colorectal cancer was low, such as Colombia, the frequency of adenomas was also low.[6] In the southern United States where there is a high prevalence of colorectal cancer, the prevalence of adenomas is much greater. Moreover, the same study showed that adenomas in American patients were bigger than those in Colombian patients. They were also more villous and more often showed severe epithelial dysplasia.

Thus it seems that the adenoma is an important precancerous lesion. It is hoped that epidemiologists will study the adenoma from their particuar point of view in the same way as they have studied invasive cancer. This will require meticulous autopsy studies in various parts of the world with differing incidences of colorectal malignant disease.

Life History of the Adenoma — Carcinoma Sequence

What is the time scale life history of the adenoma–carcinoma sequence? There is anecdotal evidence that suggests how this sequence evolves. We have had four patients with tubular adenomas that were not removed because the patients refused treatment.[4] The first two cases that presented as benign adenomas became proven and obvious cancers 5 years later. In the third case the adenoma took no less than 13 or 14 years apparently to evolve into cancer. In the fourth the adenoma appears almost exactly as it did originally 12 years ago. Similar anecdotal observations have been made on carcinoma in situ of the cervix; this entity can retain its in situ characteristics for a great length of time and apparently may even regress. It is known that adenomas in the rectal stump after ileorectal anastomosis for familial polyposis can regress. This must mean that environmental factors are operating that control the growth of this epithelial proliferation.

The same situation is seen with villous adenomas. One villous adenoma under our observation took 10 years to become cancerous.[4] Another took 30 years. Yet another patient had a villous adenoma that remained benign for 22 years; the patient died from a different cause. So although villous adenomas have high potential for malignant change, they do not inevitably become malignant, either within a few years or indeed at any time in the patient's life span. The situation is in truth unpredictable.

In patients with familial polyposis the average age at diagnosis of adenomas that showed no malignant change is 13 years younger than the average age at which cancer is diagnosed.[7] This suggests that, on average, the adenoma–carcinoma sequence takes about 13 years to evolve. In our series there were four patients with familial polyposis who received no surgical treatment and who were kept under surveillance for 20 years without the development of cancer in that time. Thus, adenomas can remain dormant for a long period without becoming malignant. Moreover, although there may be thousands of adenomas in the colon of a patient with familial polyposis, only one, two or three, at the most four or five, cancers will develop. Why only five cancers? Why not thousands of cancers? It must mean that whatever is influencing the growth of adenomas and promoting the advance of the adenoma–carcinoma sequence is operating unequally for different tumours at different sites.

Thus the adenoma–carcinoma sequence is a process that evolves slowly but on average takes 10 to 15 years. It is probably exceptional for it to take less than 5 years. It is probably quite common for it to take 20 to 30 years. In other words, at the site of a large cancer of the colon or rectum seen at laparotomy, for example, a morphologically recognizable lesion has been present for a very long time. Also, the precancerous phase, that is, the adenoma part of the adenoma–carcinoma sequence, is usually asymptomatic, so that when we see cancer it is usually at an advanced stage of its development. This makes cancer prevention programs more difficult to devise. Most adenomas probably do not become cancers during a normal life span, but if only a small percentage do so, this is sufficient to account for the prevalence of the disease in our population and indicates that the adenoma is a marker for increased risk and no more than that. My own view is that the great majority of cancers of the colorectum do evolve through the sequence.

The colonoscope and the air contrast barium enema allow an accurate examination of the large bowel. It is now realized that patients with either adenomas or carcinomas, or both, have a substantial chance of having more than one tumour. Meticulous examination of the entire bowel is essential in any patient who presents with a tumour in any one part of it. Likewise patients with adenomas and carcinomas have an increased risk of developing further (metachronous) tumours. Therefore after polypectomy or removal of a part of the large bowel the remaining colon and rectum must be kept under regular careful observation for the future development of a second, third, fourth or even fifth lesion.

Since adenomas have malignant potential, their removal is cancer prevention at a clinical level. The discovery of an adenoma or cancer in any part of the large bowel must be followed by intensive investigation of the whole organ. After removal of a tumour, if

an air contrast enema shows the remaining large bowel to be free of additional tumours, the duration of the adenoma–carcinoma sequence tells us that these examinations need not be repeated very frequently. Once every 3 years would be quite sufficient provided that no tumours are present in the large bowel that remains. Another means of cancer prevention is the regular examination of patients with a family history of bowel cancer, since they are at increased risk.[8] Other groups requiring screening are patients with familial polyposis and those with a long history of extensive ulcerative colitis.[9]

Treatment of Early Colorectal Cancer

The definition of what is meant by cancer in colorectal malignant disease is important. Whether the lesion is a polyp on a stalk or a sessile lump or a flat lesion, there is a fundamental fact that must be taken into account for the proper management of patients, namely, that the neoplastic process has no potential for lymph-node metastasis or blood-borne metastasis until neoplastic cells have crossed the muscularis mucosae. Clinical experience from follow-up has proven this.

One peculiarity of large-bowel mucous membrane is that it has few lymphatic channels in contrast to the abundance of lymphatic channels in small-bowel mucosa and in gastric mucosa. However, in the submucosal layer there are not only lymphatics but a much larger venous plexus, unlike the capillary plexus in the mucosa. For a cancer that has spread to the submucosal layer, the potential for lymph-node metastasis is of the order of 5%. If from that group of 5% the poorly differentiated adenocarcinomas are excluded, the potential for metastasis for well-differentiated and moderately well-differentiated adenocarcinomas that have invaded the submucosal layer only, is merely 1% to 2%. Are major operations with the removal of the lymphatic field justified for early colorectal cancers that have invaded the submucosal layer only?

To illustrate the point, a tubulovillous adenoma on a stalk may show areas of carcinoma in situ or focal cancer, but no spread beyond the line of the muscularis mucosae can be demonstrated in many sections through the whole tumour. Despite the presence of cytologically malignant tissue such an adenoma is not clinically malignant and therefore treatment does not need to include regional lymphadenectomy. Complete removal of adenomas is not followed by recurrence. An adenoma on a stalk with invasion of the stalk (i.e., the submucosa) by adenocarcinoma can also be cured by local excision. Can we depend further on local excision in the treatment of cancer of the colon as well as of the rectum now that therapeutic colonoscopy is available? Surgeons are able to perform full-thickness local excisions of the rectal wall. At St. Mark's Hospital in London, 143 patients with cancers of the distal colon and rectum that had invaded the submucosa only (a few had gone deeper) were treated by local excision initially.[10] Careful histologic examination revealed that 91 had been completely removed, in 14 the local excision had been doubtfully complete and in another 14 probably incomplete, for a total of 119. In the balance of cases the surgeon or the pathologist decided that local excision had not been sufficient and a major operation was appropriate. The age range and sex of this group of patients in no way differed from those in our general series of patients with colorectal cancers. The results of follow-up for as long as 20 years show that among the 91 patients with complete local excision there were five recurrences. We believe that three of these recurrences were failures of the policy in the sense that there is sufficient evidence that local excision should have been followed by a further major operation. In the two others it is doubtful whether a further major operation would have made any difference to the outcome. Among those in whom the local excision seemed to be doubtfully complete, there were only two recurrences and among the patients considered to have incomplete excision there were five recurrences. Because excision was incomplete these cannot be considered policy failures. Further operation was advised but was not performed for a variety of reasons, mostly because of advanced age. It appears that when a specimen shows histologic evidence of growth at its margin, residual tumour may have been destroyed by the diathermy excision. In such instances local excision has, in fact, been complete. I am not saying that the place of local excision is only for the elderly or those in poor general health with high risk of death after a major operation. There is a place for local excision as an alternative to both abdominoperineal excision and anterior resection. We ought to move further towards defining the place of local excision. A policy of total biopsy and examination by the pathologist is necessary. If local excision is complete, we do not advise any further operation unless the tumour is highly malignant. Since 1948 the proportion of local excisions to major operations performed at the St. Mark's Hospital has increased steadily each year. Now nearly 10% of our operations for colorectal cancer are local excisions, admittedly mostly for smaller tumours and including those removed by colonoscopic polypectomy.

A local excision should be a safe operation, whereas a major operation is far from safe. The postoperative mortality reported for major operations varies from 17% to 1.9%. Therefore the balance of risks as well as the technical aspects of local excision have to be considered. This is a challenge to surgeons to consider local excision as an alternative treatment for early colorectal cancer.

References

1. Morson BC, Bussey HJR: Predisposing causes of intestinal cancer. *Curr Probl Surg* 1, Feb. 1970
2. Enterline HT: Polyps and cancer of the large bowel, in *Pathology of the Gastrointestinal Tract,* vol 63, Morson BC (ed), Berlin, Springer-Verlag, 1976, pp 95-141
3. Morson BC, Sobin LH (eds): *Histological Typing of Intestinal Tumours,* WHO classification no. 15, Geneva, WHO, 1976
4. Muto T, Bussey HJR, Morson BC: The evolution of cancer of the colon and rectum. *Cancer* 36: 2251, 1975
5. Muto T, Ishikawa K, Kino I, et al: Comparative histologic study of adenomas of the large intestine in Japan and England, with special reference to malignant potential. *Dis Colon Rectum* 20: 11, 1977
6. Correa P, Duque E, Cuello C, et al: Polyps of the colon and rectum in Cali, Colombia. *Int J Cancer* 9: 86, 1972
7. Bussey HJR: *Familial Polyposis Coli,* Baltimore, Johns Hopkins, 1975
8. Lovett E: Family studies in cancer of the colon and rectum. *Br J Surg* 63: 13, 1976
9. Lennard-Jones JE, Morson BC, Ritchie JK, et al: Cancer in colitis: assessment of the individual risk by clinical and histological criteria. *Gastroenterology* 73: 1280, 1977
10. Morson BC, Bussey HJR, Samoorian S: A policy of local excision for early cancer of the colorectum. *Gut* 18: 1045, 1977

Correction

On page 107 of the March 1978 issue of the Journal, the address for reprints of the article "Profundoplasty for Limb Salvage" by T.E. David and J.A. Key should read: Dr. Tirone E. David, UW8 - 110, Toronto General Hospital, Toronto, Ont. M5G 1L7.

2. Epidemiology of Colorectal Cancer

A.B. MILLER, MB, B CHIR, FRCP[C]*

Data from international sources and from Canada are reviewed concerning the incidence and mortality for colorectal cancer. Nutritional factors are almost certainly relevant in etiology although, with differing sex ratios for different sites of the colon and rectum, it cannot be assumed that they will operate to the same extent throughout the large bowel. The results of studies currently available are conflicting and further study is obviously required.

Des données d'origine internationale et canadienne portant sur l'incidence et la mortalité du cancer colorectal sont passées en revue. Des facteurs nutritifs sont presque certainement reliés à son étiologie, bien qu'avec des rapports de sexe différents pour différents points du côlon et du rectum, on ne puisse supposer qu'ils exercent la même influence à travers tout le gros intestin. Les résultats des études présentement disponibles sont divergents et d'autres études sont, de toute évidence, nécessaires.

In Canada the lifetime risk of colorectal cancer developing is just under 4% for men and a little over 3% for women. This expression is somewhat artificial but it allows a comparison of the lifetime probability of persons in various countries having colorectal cancer if they were to survive to 75 years of age.[1] It is a method of age standardization that assumes an equal population in each age group. In relation to other cancers, in Canada colorectal cancer has the second highest incidence in both men and women.

Another way of identifying the relative importance of a malignant disease is to calculate the potential years of life lost before 70 years of age. This figure is an indication of premature death. The years of life that appear to have been lost owing to a condition are cumulated assuming no deaths occur from other causes.[2] In 1973 in Canada, deaths from colorectal cancer before the age of 70 resulted in a loss of 14 000 potential years in men and 13 000 in women. Compared with other cancers, colorectal cancer is second to lung cancer in terms of premature death in men and second to breast cancer in women. Accumulated across both sexes, colorectal cancer is second only to lung cancer.

Mortality data from Canada show little change in the period from 1954 to 1974.[3] There is an indication of a change in the sex ratio for carcinoma of the large intestine, the mortality in females decreasing slightly and the mortality in males increasing. For cancer of the rectum the rates were stable, males having a higher mortality than females.

International statistics show the incidence of colorectal cancer to be highest in Canada (actually in Saskatchewan) with the United States (Connecticut) not far behind, the United Kingdom quite a bit lower on the list, Japan close to the bottom and Nigeria last.[4] Are the substantial differences in incidence of colorectal cancer due to environmental factors? There is a large body of evidence suggesting that they are and that at least 80% of cancers of the colon and rectum are preventable, if the causes could be found and removed from the environment.

By and large, the incidence of breast cancer and of colorectal cancer runs parallel. There are a number of similarities between the epidemiology referable to these two sites, suggesting that similar factors may be responsible.[5]

The ratios of age-standardized incidence for the sexes of cancer of the colon and cancer of the rectum deserve study. These have been calculated from the published data.[4] For cancer of the colon in Canada (Saskatchewan) the slight excess in the number of females makes the male/female ratio of incidence just below unity. In the US (Connecticut) the incidence for males and females is identical, in the UK the ratio is very close to unity and in Sweden it is just above unity. It appears that in North America and Europe, the male/female incidence ratio for colonic cancer is approximately unity. In the black population of the US (California) the ratio falls below unity, since more females than males have colonic cancer. For rectal cancer the sex ratio shows a substantial excess in the number of males in Canada, the US, the UK and Sweden. It is nearer unity for Israel, Finland, Japan and South Africa. There seems to be a difference in sex ratios for rectal cancer between Western and North American countries and other parts of the world. This is a factor that has to be noted in considering etiology.

In Canada[6] the incidence of cancer of the cecum and descending colon is lower in males than in females, the ratio being well below unity. For the transverse colon, it is close to unity. In males, the incidence of cancer of the sigmoid colon has a slight excess, of the rectosigmoid junction a greater excess and of the rectum a significant excess over that in females. The sex incidence ratios change in proceeding from the cecum to the rectum. In males the highest incidence of cancer of the large bowel is in the rectum. In females, the incidence of rectal cancer is only slightly higher than that of cecal cancer, whereas in males the incidence of cecal cancer is substantially lower and that of cancer of the sigmoid colon is quite high.

In low-risk populations in Africa and Asia the cecum and descending colon tend to predominate as the sites of large-bowel cancer and females tend to have more cancer of the colorectum than males. In high-risk populations there is more sigmoid cancer than in low-risk populations.[7] With changing trends there seems to be an increase first in males, later in females. Migration results in a rapid increase in colorectal cancer, particularly in sigmoid cancer, if persons move from a low-incidence population to a high-incidence population. When populations migrate the expected changes in the incidence of breast cancer take a long time to occur but changes in incidence of colonic cancer take a relatively short time. In North America recently there has been a decrease in cancers of the lower rectum and an increase in the male/female ratio for colonic cancers.

Presented at the Canadian Oncology Society symposium on colorectal cancer, held at the annual meeting of the Royal College of Physicians and Surgeons of Canada, Toronto, Ont., Jan. 27, 1977

**Director, epidemiology unit, National Cancer Institute of Canada, Toronto*

Reprint requests to: Dr A.B. Miller, Director, National Cancer Institute of Canada epidemiology unit, McMurrich Building, University of Toronto, Toronto, Ont. M5S 1A8

Cancer of the rectum is more commonly out of reach of the examining finger, so that use of the sigmoidoscope is more often necessary for its diagnosis.

Epidemiologic studies have identified other factors associated with colorectal cancer.[8] The disease occurs more frequently in urban than in rural populations and in persons of higher socioeconomic status. Moreover, colorectal cancer seems to be characteristic of populations with a short intestinal transit time, as well as of persons who have a high excretion of fecal bile acids and steroids. It has also been associated with the kind of intestinal microflora present, a type of *Clostridia* being implicated. Other associated features are a low serum cholesterol concentration, a low intake of fibre, a high intake of dietary fat and animal protein and a high intake of beer.

Two recent case-control studies[9,10] attempted to evaluate diet in relation to colonic and rectal cancer. The relative risk of large-bowel cancer in Hawaiian Japanese was higher for those who ate small numbers of Japanese meals daily (none or one daily) than for those who ate more than one daily.[9] Those who ate a large amount of beef (eight or more pounds per month) had a high relative risk. Those who ate a lot of meat, string beans or legumes, and a low amount of starch had a high relative risk. The important risk factor seemed to be beef, which may account for a number of the other associations. Some biochemical studies tend to confirm this. But beef consumption is accompanied by a high fat intake so it is by no means certain that beef is the responsible factor.

In contrast, a study in Israel examined fibre consumption.[10] Analysis revealed that patients who consumed no fibre or only small amounts had a higher incidence of bowel cancer than those with a high fibre consumption. Low fibre content of diets was related to the incidence of colonic cancer but not of rectal cancer.

What can be the mechanism? Hill and associates[11] suggest that it is not fibre that is important but dietary fat; the action of intestinal bacteria on fecal bile acids (the amount of which is dependent on fat intake) produces carcinogens that cause intestinal cancer. By an alternative mechanism dietary fat may influence the frequency of breast cancer;[12] bacteria in the bowel can produce estrogens from biliary steroids present in the colon.

In summary, nutrition has an important bearing on the incidence of bowel cancer. One of the major changes in the lives of persons who migrate and one of the major differences between populations on an international scale is their diet. It may be difficult to confirm such hypotheses, but already it is being recommended that we eat smaller steaks, reduce our fat intake and eat more fruit and vegetables.

References

1. DAY NE: A new measure of age standardized incidence, the cumulative rate, in *Cancer Incidence in Five Continents,* vol 3, WATERHOUSE J, MUIR C, CORREA P, et al (eds), Lyon, International Agency for Research on Cancer, 1976, pp 443-445
2. ROMEDER JM, MCWHINNIE JR: Potential years of life lost between ages 1 and 70: an indicator of premature mortality for health planning. *Int J Epidemiol* 6: 143, 1977
3. Statistics Canada: *Vital Statistics, Volume 3—Deaths,* cat 84-206 annual, Ottawa, Statistics Canada, 1954 to 1974
4. DOLL R, MUIR C, WATERHOUSE J (eds): *Cancer Incidence in Five Continents,* vol 2, New York, Springer-Verlag, 1970
5. HOWELL MA: The association between colorectal cancer and breast cancer. *J Chronic Dis* 29: 243, 1976
6. Statistics Canada: *New Primary Sites of Malignant Neoplasms in Canada (As Reported by Provincial Tumour Registries), 1973,* cat 82-207 annual, Ottawa, Statistics Canada, 1976
7. HAENSZEL W, CORREA P: Cancer of the colon and rectum and adenomatous polyps. A review of epidemiologic findings. *Cancer* 28: 14, 1971
8. HOWELL MA: Diet as an etiological factor in the development of cancers of the colon and rectum. *J Chronic Dis* 28: 67, 1975
9. HAENSZEL W, BERG JW, SEGI M, et al: Large-bowel cancer in Hawaiian Japanese. *J Natl Cancer Inst* 51: 1765, 1973
10. MODAN B, BARELL V, LUBIN F, et al: Low-fiber intake as an etiologic factor in cancer of the colon. *J Natl Cancer Inst* 55: 15, 1975
11. HILL MJ, DRASAR BS, WILLIAMS REO, et al: Faecal bile-acids and Clostridia in patients with cancer of the large bowel. *Lancet* 1: 535, 1975
12. HILL MJ, GODDARD P, WILLIAMS REO: Gut bacteria and aetiology of cancer of the breast. *Lancet* 2: 472, 1971

BOOKS RECEIVED

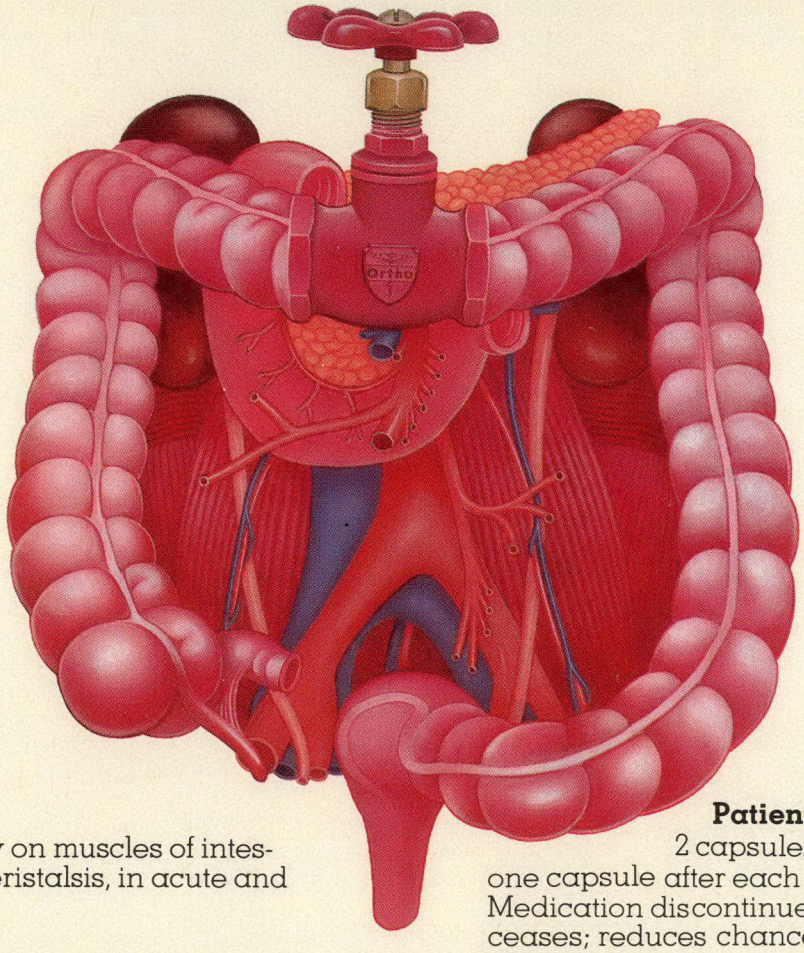
This list is an acknowledgement of books received. It does not preclude review at a later date.

Advances in Surgery. Volume 11. 1977. Edited by Charles Rob, James D. Hardy, George L. Jordan, Jr., and others. 415 pp. Illust. Year Book Medical Publishers, Inc., Chicago, 1977. Price not stated. ISBN 0-8151-7365-2.

Actualités Chirurgicales. 78e Congrès Français de Chirurgie. I. Chirurgie Abdominale et Digestive, Première Partie. Textes publiés sous la direction de J.-Cl. Patel. 181 pp. Illust. Masson, Paris, 1977. Price not stated, paperbound. ISBN 2-225-47487-7.

continued on page 213

Imodium* Capsules
a non-narcotic antidiarrheal



Single-entity drug
IMODIUM acts locally on muscles of intestinal wall to inhibit peristalsis, in acute and chronic cases.

Non-narcotic
No atropine; may be administered for long periods of time—vital in chronic cases.[1, 2]

Effective
"Loperamide (IMODIUM) is about 3 times more potent than diphenoxylate . . . significantly longer action."[3]

Telephone prescriptions
Convenient in emergency cases.

Full prescribing information available upon request.
IMODIUM is an original product of Janssen Pharmaceutica, Belgium

PAAB
CCPP

Patient-controlled dosage
2 capsules stat followed by one capsule after each unformed stool. Medication discontinued when diarrhea ceases; reduces chance of constipation.

Compatible
No evidence of drug interaction; does not potentiate barbiturates and tranquilizers.[1, 2]

References:
1. Data on file, Ortho Pharmaceutical (Canada) Ltd.
2. Galambos, J.T., Hersh, T., Schroder, S., Wenger, J.: Loperamide: A new antidiarrheal agent in the treatment of chronic diarrhea. Gastroenterology, Vol. 70, 6, June 1976.
3. Pelemans, W., Vantrappen, G.: A double blind crossover comparison of loperamide with diphenoxylate in the symptomatic treatment of chronic diarrhea. Gastroenterology, Vol. 70, 6, June, 1976.

Ortho ORTHO PHARMACEUTICAL
(CANADA) LTD.-DON MILLS, ONTARIO

*Trademark

Imodium
For effective relief of acute and chronic diarrhea without narcotic side effects.

3. Immunology and Immunotherapy of Colorectal Cancer

PHIL GOLD, MD, PH D, FRSC, FRCP[C]*

Adenocarcinomas of the human colon produce carcinoembryonic antigen (CEA), one of a family of glycoprotein molecules that may be produced by various human cancers and, occasionally, by other abnormal tissues. The physicochemical nature and tissue distribution of CEA have been well established and a variety of radioimmunoassays have been developed for the detection of this material in the circulation of patients with CEA-producing tumours. Although the assay should not be used as a screening test for cancer of the bowel, it may serve as a helpful adjunct in the diagnosis of digestive system tumours in conjunction with other routine investigations. More important is the utilization of the radioimmunoassay for CEA under the following circumstances:

1. Preoperatively as an indicator of tumour dissemination based upon the quantitative concentrations of CEA in the circulation.

2. As an indicator of potentially curative resection manifested by a decrease in circulating concentrations of CEA to below detectable limits.

3. As an early warning of recurrent tumour growth, by detecting the reappearance of CEA in the circulation of a patient rendered CEA-negative after tumour resection, 3 months to 2 years or more before any other presently available technology can detect clinical evidence of recurrence.

This last observation is now under investigation for its potential value as an indicator for second-look surgery in patients who have undergone potentially curative surgery for colorectal cancers.

Chez l'humain, les adénocarcinomes du côlon produisent l'antigène carcino-embryonnaire (ACE), un d'une famille de glycoprotéines pouvant être produites par divers cancers humains et, occasionnellement, par d'autres tissus anormaux. La nature physicochimique et la distribution tissulaire de l'ACE ont été bien établies et plusieurs méthodes radioimmunologiques ont été mises au point par la détection de cette substance dans la circulation des patients porteurs de tumeurs productrices d'ACE. Bien qu'une telle méthode ne doive pas être utilisée comme test de dépistage du cancer de l'intestin, elle peut servir comme mesure d'appoint dans le diagnostic des tumeurs du système digestif conjointement avec d'autres épreuves courantes. Plus importante est l'utilisation que l'on fait du dosage radioimmunologique de l'ACE dans les circonstances suivantes:

1. En préopératoire, comme indicateur de dissémination tumorale en s'appuyant sur la quantification de l'ACE dans la circulation.

2. Comme indicateur du succès éventuel d'une résection à visées curatives, qui se manifeste par une baisse de concentrations d'ACE circulant en deçà des limites de détection.

3. Comme signal précoce d'une récidive tumorale, en décelant la réapparition de l'ACE dans la circulation chez un patient devenu ACE négatif après une résection tumorale, de 3 mois à 2 ans ou plus avant que toute autre technique présentement disponible ne puisse déceler la preuve clinique d'un récidive.

Cette dernière observation est maintenant à l'étude pour sa valeur éventuelle comme indicateur d'une chirurgie exploratrice chez les patients qui ont subit une chirurgie à visées curatives pour un cancer colorectal.

From the division of clinical immunology and allergy and the McGill University medical clinic of the Montreal General Hospital, Montreal, PQ

Presented at the Canadian Oncology Society symposium on colorectal cancer, held at the annual meeting of the Royal College of Physicians and Surgeons of Canada, Toronto, Ont., Jan. 27, 1977

Portions of the studies reported have been supported by the Medical Research Council of Canada, the National Cancer Institute of Canada and the Cancer Research Society, Inc.

**Professor of medicine and physiology, and director, McGill cancer center, McGill University, Montreal; associate, Medical Research Council of Canada*

Reprint requests to: Dr. Phil Gold, Rm. 7135, The Montreal General Hospital, 1650 Cedar Ave., Montreal, PQ H3G 1A4

All adenocarcinomas of the human bowel produce one or more molecules of a family of immunologically cross-reactive tumour antigens, collectively designated carcinoembryonic antigen (CEA). Nevertheless, the material denoted CEA is found in all endodermally derived digestive-system tumours as well as in the fetal gut, liver and pancreas in the first two trimesters of gestation. This material is not found in other fetal tissues at any other time during gestation. Again, CEA-like materials may be produced by other types of cancerous tissues, but their exact nature has yet to be elucidated. CEA, which is a relatively large glycoprotein, is found at least in part in the glycocalyx of the tumour cell. It is from this site that the CEA may be released into the circulation of the patient.

Since the original publication describing a radioimmunoassay for CEA,[1,2] a great many modifications of the procedure have been described.[1,2] The assay most frequently employed at present, and commercially available, is the Z-gel assay marketed by Hoffmann-La Roche Ltd.

Although we have been able to demonstrate the presence of CEA by tissue extraction only in bowel cancer, this limitation does not apparently apply to sera. Some 11% of healthy individuals were found to have a measurable concentration of CEA in their sera (i.e., greater than 2.5 ng/mL of serum, the limit of sensitivity of the assay). The frequency of elevation of serum CEA or CEA-like material among smokers is 19%, whereas in nonsmokers it is only 3%. If smokers stop smoking, the concentration of serum CEA in the majority decreases to undetectable levels. In some of them, however, it does not. Thus, smokers apparently in good health may have CEA, or a CEA-like material, identifiable in their sera. Except in the malignant diseases that will be considered below, the CEA is usually of low concentration (range, 2.5 to 5.0 ng/mL). Moreover, in such individuals the values tend to fluctuate between these relatively low values or to reach a plateau, and do not show a tendency to increase. When increases do occur, it is

likely that the disease has begun to progress.

In malignant diseases of the colorectum, the more advanced the stage of the disease, the higher is the frequency of positive assays and, indeed, the higher is the concentration of CEA in the serum or plasma. The frequency of elevated CEA concentrations is high in patients with carcinoma of the stomach and of the pancreas. It is somewhat lower in cases of primary hepatoma. Nonenteric cancers may produce positive CEA assays (e.g., cancers of the breast, bladder, female pelvic organs, etc.). Some nonmalignant diseases, such as cirrhosis of the liver and ulcerative colitis may also be associated with elevations in the concentration of CEA.

Why are such "false-positive" assays observed? These probably result from some of the determinants on a molecule of CEA resembling those produced by other pathologic conditions or even by normal tissues. If the antibodies against these determinants are not completely removed from the reagent anti-CEA antiserum used in the assay, a positive reaction with the materials produced by other pathologic, or even normal, tissues may occur. The absorption of the reagent antiserum is, therefore, crucial.

Use of CEA in Diagnosis of Colorectal Cancer

The CEA assay is *not* a screening test for cancer. It should never be employed in this fashion except in situations where a clinician strongly suspects cancer. In such situations a positive CEA assay may be obtained up to 24 months or more prior to the demonstration of the tumour by either endoscopic or radiologic means. In addition, the CEA assay may be of value in the examination of populations at high risk of developing CEA-associated cancers. Hence, in the community of Busselton, Australia, 960 serum samples were examined for CEA concentration in 1969 and this procedure was repeated on the same population in 1973.[1] In 18 (2%) of the 912 initially CEA-negative subjects CEA-associated cancers had developed in the interval, whereas in 8 (18.5%) of the 44 initially CEA-positive subjects such tumours had developed. Six of the latter group had already died of their cancers and two were found to have occult malignant lesions of the colorectum upon subsequent examination. Whether the cost–benefit ratio is worth while in such populations remains to be determined.

It has been demonstrated[1] quite clearly that in cases of pancreatic and colonic cancer, a combination of the standard, generally available diagnostic techniques with the CEA assay provides a higher degree of diagnostic accuracy than either method alone.

What information can be supplied by the CEA assay prior to surgery in a patient with an established colorectal cancer? Here it has been proved that the CEA value provides most important preoperative prognostic evidence. If the CEA value is either low or undetectable, resection of a localized tumour has an excellent possibility of being curative. The higher the preoperative value of CEA, the less likelihood there is of truly curative resection and the greater the chance of tumour dissemination during the operation and of early observation of metastatic lesions postoperatively.

After resection of cancers that apparently have not metastasized, the CEA value tends to decrease in some cases, while in others it remains elevated. If it remains elevated over a period of weeks, almost invariably metastases are found quite soon after operation. On the other hand, in individuals in whom the CEA value falls below the limits of detectability postoperatively, and remains undetectable or of the order of 2.5 to 5.0 ng/mL without showing progressive rise, clinical recurrence of tumour is seldom seen. If, however, after an initial fall in CEA value to undetectable concentrations postoperatively there should be a persistent reappearance of CEA in the circulation and an increasing concentration, the recurrence of malignant growth is almost certain.

At present its predictive value as a marker for the recurrence of colorectal cancer growth is perhaps the most useful function of the CEA assay. This observation has been made repeatedly in a number of laboratories throughout the world and has, very recently, been translated into a practical approach to the postoperative management of patients with colorectal cancer.[3-6] Thus, in a number of centres in both North America and abroad, a rising value of CEA, under well-defined and well-controlled circumstances, is being used as an indication for second-look surgery for cancer recurrence. The reports of this type of procedure are most encouraging in that localized lesions have apparently been found and resected with excellent results.[4] A great deal more study is required of this approach, and caution should be exercised in utilizing this new tool as a basis for second-look surgery. It is noteworthy that the Society of Surgical Oncology in the United States is now planning a nation-wide trial in patients with cancer of the colon of second-look surgery based on rising CEA values in controlled settings.

Immunotherapy of Colorectal Cancer

The studies done so far in the area of immunotherapy of colorectal cancer have provided no definitive information on the efficacy of this mode of treatment. Indeed, at the moment immunotherapy does not appear to have much to offer in the management of patients with colorectal cancer. However, from a theoretical standpoint it can be claimed that the tumour must be reduced in bulk in order to lower the total number of cells remaining to 10^5 or fewer. In addition, the patient must have a functional immunologic system, since without this form of reactivity immunotherapy cannot possibly be effective.

References

1. Fuks A, Banjo C, Shuster J, et al: Carcinoembryonic antigen (CEA): molecular biology and clinical significance. *Biochim Biophys Acta* 417: 123, 1975
2. Terry WD, Henkert PA, Coligan JE, et al: Carcinoembryonic antigen: characterization and clinical applications. *Transplant Rev* 20: 100, 1974
3. Gold P, Freedman SO: Tests for carcinoembryonic antigen. Role in diagnosis and management of cancer. *JAMA* 234: 190, 1975
4. Balz JB, Martin EW, Minton JP: CEA as an early indicator for second-look procedure in colorectal cancer. *Rev Surg* 34: 1, 1977
5. Maugh TH: Biochemical markers: early warning signs of cancer (E). *Science* 197: 543, 1977
6. Proceedings of international conference on the clinical uses of carcinoembryonic antigen, Lexington, KY, June 1977. *Cancer* (suppl) (in press)

BOOKS RECEIVED

continued from page 210

Actualités Chirurgicales. 78e Congrès Français de Chirurgie. II. Chirurgie Abdominale et Digestive. Deuxième Partie. Chirurgie Urologique et Gynécologique. Textes publiés sous la direction de J.-Cl. Patel. 177 pp. Illust. Masson, Paris, 1977. Price not stated, paperbound. ISBN 2-225-47498-2.

Actualités Chirurgicales. 78e Congrès Français de Chirurgie. III. Chirurgie Vasculaire et Thoracique, Microchirurgie, Communications Diverses. Textes publiés sous la direction de J.-Cl. Patel. 165 pp. Illust. Masson, Paris, 1977. Price not stated, paperbound. ISBN 2-225-47509-1.

Actualités Chirurgicales. 78e Congrès Français de Chirurgie. IV. Orthopédie et Traumatologie. Chirurgie Générale et Anesthésie-Réanimation. Textes publiés sous la direction de J.-Cl. Patel. 162 pp. Illust. Masson, Paris, 1977. Price not stated, paperbound. ISBN 2-225-47510-5.

Anatomy. Regional and Applied. 6th ed. R.J. Last. 598 pp. Illust. Churchill Livingstone, Edinburgh; Longman Canada Limited, Don Mills, 1978. $35, paperbound. ISBN 0-443-01317-9.

continued on page 229

4. Surgery of Colorectal Cancer

S. ARTHUR LOCALIO, MD, D SC(MED), FACS*

Studies on lymphatic spread of rectal cancer have established the rationale for sphincter preservation in the treatment of midrectal cancer. This entity comprises lesions located 5.5 to 10 cm above the anal verge in women and 7 to 11 cm in men.

Abdominosacral resection is a logical means for restoring intestinal continuity after radical resection for midrectal cancer. Direct posterior exposure of the distal limit of resection above the pelvic floor allows accurate construction of the anastomosis without disturbing the anorectal structures or their innervation and maintains essentially normal anal continence. The procedure is preferable to the various pull-through operations. Survival rates for patients undergoing anterior resection, abdominosacral resection and abdominoperineal resection are comparable.

Des études portant sur l'envahissement du système lymphatique par un cancer rectal ont dégagé les conditions nécessaires à la conservation du sphincter lors du traitement d'un cancer du centre du rectum. Ceci comprend les lésions situées de 5.5 à 10 cm au-dessus du bord de l'anus chez la femme, et de 7 à 11 cm chez l'homme.

La résection abdominosacré est un moyen logique de rétablir la continuité intestinale après une résection radicale pour un cancer du centre du rectum. Un abord postérieur direct de la partie distale de la résection, au dessus du plancher pelvien, permet la construction de l'anastomose sans affecter l'innervation des structures anorectales et maintient une continence anale essentiellement normale. Cette intervention est préférable aux diverses opérations transanales. Les taux de survie pour les patients qui subissent une résection antérieure, une résection abdominosacrée ou une résection abdominopérinéale sont comparables.

Presented at the Canadian Oncology Society symposium on colorectal cancer, held at the annual meeting of the Royal College of Physicians and Surgeons of Canada, Toronto, Ont., Jan. 27, 1977

**Professor of surgery, New York University Medical Center, school of medicine, New York; Johnson & Johnson distinguished professor of surgery*

Reprint requests to: Dr. S.A. Localio, 560 First Ave., New York, NY 10016, USA

The American Cancer Society estimates that in 1977 in the United States there will be 101 000 new cases of cancer of the colon and 51 000 deaths from this disease. About 50% of the patients in whom carcinoma of the colon develops will be alive and well 5 years after the tumour has been diagnosed but the other 50% will have died within that period.

The stage of disease determines the chance of survival. The Dukes' classification[1] reflects the duration and biologic behaviour of the growth. About 15% of patients have a Dukes' A lesion and virtually all are curable. Patients whose tumour is classified as Dukes' B represent about 35% of all patients and have a 70% chance of being alive and free of disease after 5 years. About 50% of patients have a Dukes' C lesion and in these persons the success rate decreases to about 30%. The salvage rate for patients with distant metastases is virtually zero.

One way to increase the salvage rate of patients with carcinoma of the colon is to make the diagnosis at an earlier stage. The American Cancer Society tries to accomplish this by educating the public, the physician and the surgeon. Screening by rectal examination, examination of the stool for occult blood and sigmoidoscopy are easily done. The small group of persons at great risk — those with multiple polyps or congenital polyposis, patients with long-standing ulcerative colitis (particularly if the disease had its onset during youth), the individual who previously has had carcinoma of the colon and those who have a family history of carcinoma of the colon — require more intensive investigation. Further evaluation by barium contrast enema and colonoscopy should be performed in the presence of any of the above indications.

Even the poor-risk patient can undergo surgery for cancer of the colon with the expectation of modest morbidity and acceptable mortality. A mortality of 2% in a large series of unselected patients is possible. For the past 10 years we have made a special attempt to preserve normal sphincter function in a specific group of patients with cancer of the rectum. Our policy has been to treat cancers of the upper third of the rectum by anterior resection, those in the lower third of the rectum by standard abdominoperineal resection[2] and cancers of the middle third of the rectum by abdominosacral resection.

We define upper third cancers as lesions more than 11 cm from the anorectal junction in men and 10 cm in women. Lesions less than 7 cm from the anorectal junction in men or 5.5 cm in women lie in the lower third. For the intermediate group (lesions between 7 and 11 cm from the anorectal junction in men and between 5.5 and 10 cm in women) we perform abdominosacral resection with preservation of the sphincters. This operation preserves both the sphincters and the mucosa as well as the sensory receptors of the lower rectum and anus. We believe the abdominosacral resection is justified because the spread of carcinoma of the midrectum is upward. Lateral or downward spread occurs only when the higher lymphatics have been choked with tumour.[3]

Technique of Abdominosacral Resection

The patient is placed in the lateral position so that the pelvis can be approached simultaneously through an abdominal incision and through a posterior incision after the coccyx has been removed. The abdominal part of the operation is similar to other abdominal operations on the rectum except that one sees the anatomic structures from a lateral instead of from an anterior view.

The posterior portion of the operation is begun without turning the patient or closing the abdominal incision. The coccyx is disarticulated from the sacrum. The posterior portion of the levator ani is detached from the coccyx. The presacral space can now be entered and the mobilized colon and rectum can be delivered through the posterior incision. The bowel is transected 3 to 4 cm above the lesion after measuring the distance with a ruler. A standard two-layer anastomosis with fine sutures is performed and covered with omentum.[4] There have been two deaths in the 100 patients we have operated on using this technique. One death was from peritonitis caused by a leak at the anastomosis and the other from myocardial infarction on the ninth postoperative day.

Results

We are at present reviewing our experience with carcinoma of the rectum in over 400 patients treated in the past 10 years by one of the three types of operation mentioned above. Our preliminary data show an overall mortality of 2%. These data indicate that for the three types of operation adopted for the treatment of rectal cancer the 5-year survival rates are comparable.

References

1. DUKES CE: Cancer of the rectum: an analysis of 1000 cases. *J Pathol* 50: 527, 1940
2. GOLIGHER JC: *Surgery of the Anus, Rectum and Colon,* 3rd ed, London, Baillière Tindall, 1975, pp 639-813
3. LOCALIO SA, ENG K: Malignant tumors of the rectum. *Curr Probl Surg* 1, Sept. 1975.
4. LOCALIO SA: Abdominosacral rectal resection, in *Surgical Techniques Illustrated,* vol. 2 no. 2, MALT RA (ed), Boston, Little, 1977, p 37

5. Radiotherapy of Colorectal Cancer

W.D. RIDER, MB, FRCP[C], FRCR(LOND)*

Radiotherapy has an increasingly important place in the management of patients with colorectal cancer. At present the exact indications have not been defined, but the following suggestions for its use can be made based on preliminary experience at the Princess Margaret Hospital, Toronto:

1. Radical irradiation could be a valuable alternative to the classical Miles' abdominoperineal excision of extraperitoneal rectal cancer.

2. Preoperative irradiation may be used for all patients undergoing surgical excision and restoration of bowel continuity.

3. Postoperative radiotherapy can be administered (a) when the tumour has penetrated the bowel wall to the serosa or beyond, (b) when the lymph nodes are involved secondarily and (c) when the distal line of resection is less than 4.0 cm from the tumour (as measured in the fixed pathological specimen).

4. Radiotherapy is useful for palliation of postsurgical recurrences and symptomatic distant metastases.

La radiothérapie prend une place de plus en plus importante dans le traitement des patients atteints de cancer colorectal. Jusqu'à maintenant, les indications précises n'ont pas été définies, mais les suggestions suivantes peuvent être avancées à partir de l'expérience préliminaire réalisée au Princess Margaret Hospital, Toronto:

1. L'irradiation radicale pourrait être une alternative acceptable à l'excision abdominopérinéale classique de Miles des cancers rectaux extrapéritonéaux.

2. L'irradiation préopératoire peut être utilisée chez tous les patients qui subissent une excision chirurgicale et le raccord de l'intestin.

3. La radiothérapie postopératoire peut être administrée (a) quand la tumeur a envahi la paroi abdominale jusqu'à la séreuse, ou au-delà (b) quand il y a atteinte secondaire des ganglions lymphatiques et (c) quand la ligne distale de résection est à moins de 4.0 cm de la tumeur (tel que mesuré sur le prélèvement pathologique fixé).

4. La radiothérapie est utile comme traitement palliatif lors des récidives postchirurgicales et en présence de métastases éloignées symptomatiques.

Most of the experience in the radiotherapy of colorectal cancer acquired at the Princess Margaret Hospital, Toronto, relates to cancer of the rectum, but some of the principles learned in the treatment of lesions of the lower bowel may well be applied to the upper large bowel.

The role of radiotherapy in colorectal cancer can be considered under three headings:

- Curative—as an alternative to abdominoperineal resection.
- Preoperative—for all levels.
- Postoperative—for special categories.

We must disabuse ourselves of the former concept that adenocarcinoma of the large bowel is radioresistant. Quite clearly it is not. Unlike squamous cell carcinoma it has a slow disappearance or regression rate (Fig. 1). Indeed, the longest period to complete regression we have documented is 26 months; at 4½ years this patient is alive without cancer in his rectum, but he has lung and liver metastases.

The acquisition of evidence that there is an alternative to the classical Miles' abdominoperineal resection for cancer of the rectum is difficult because of the tradition of surgical treatment and the mistaken idea that the tumour is radioresistant.

In the selected group of tumours that we have irradiated 75% were classified by the surgeon as inoperable because of local fixation of the growth. Over a span of 20 years we have not had a consistent policy with regard to irradiation. Each radiation oncologist simply did what he thought best (just like our surgical confrères) and, in retrospect, critical analysis makes it clear that in about one quarter of these patients the choice of irradiation was in error.

In a modest attempt to "stage" our

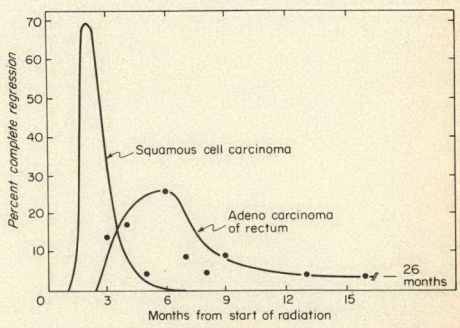


FIG. 1—Comparison of rate of complete regression after irradiation for patients with squamous cell carcinoma and adenocarcinoma of rectum, treated at Princess Margaret Hospital, Toronto.

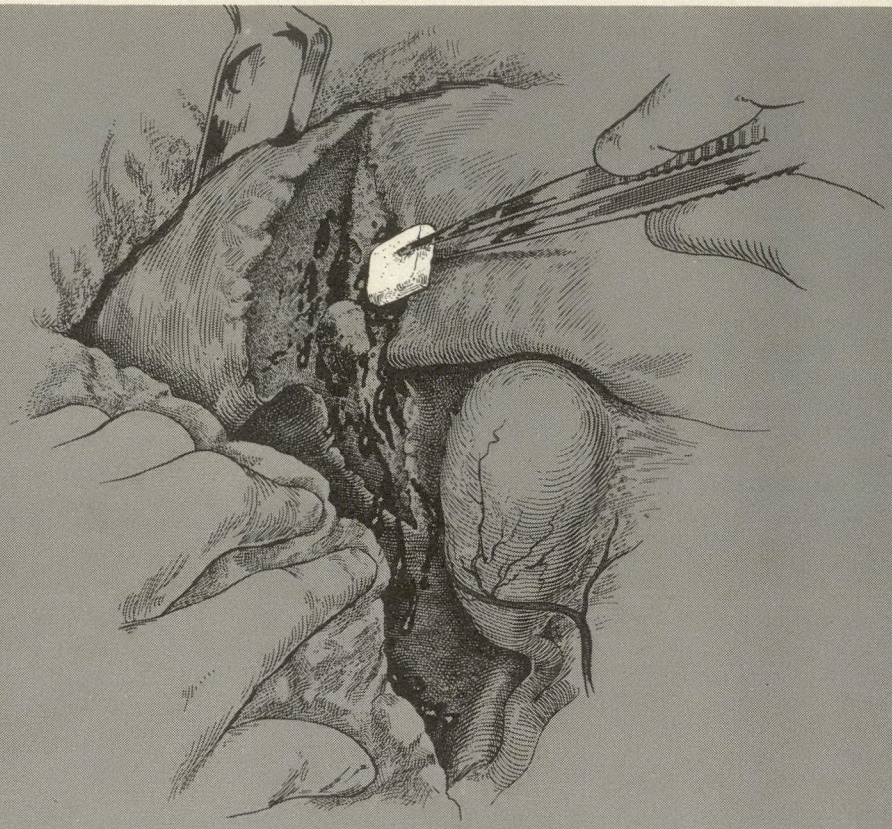
Presented at the Canadian Oncology Society symposium on colorectal cancer, held at the annual meeting of the Royal College of Physicians and Surgeons of Canada, Toronto, Ont., Jan. 27, 1977

**Professor of radiology, University of Toronto, and director, radiation oncology, The Princess Margaret Hospital, Toronto*

Reprint requests to: Dr. W.D. Rider, The Princess Margaret Hospital, 500 Sherbourne St., Toronto, Ont. M4X 1K9

Gelfoam

used by a generation of physicians in hepatic surgery, haemorrhoidectomy, cholecystectomy and decubitus ulcer



still the only absorbable haemostat that meets all these criteria:

absorbed completely in four to six weeks

safe as a permanent packing in any tissue; won't interfere with bone regeneration, cause cyst formation or excessive scar tissue

effective dry or moistened with thrombin solution, isotonic sodium chloride or antibiotic

non-irritating, naturally-occurring, neutral pH; may be cut, molded, or sutured in place when necessary

stimulates natural clotting and healing of disrupted tissue

769 REGISTERED TRADEMARK: GELFOAM, GELFILM CE 7734.3

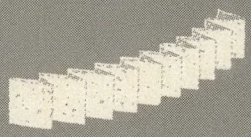
Upjohn

THE UPJOHN COMPANY OF CANADA / DON MILLS, ONTARIO

MEMBER PMAC

available in a variety of sizes, shapes and forms for most areas of surgery where haemostasis is desired

for nasal packing



Sterile Pack, size 2 cm
40 x 2 cm
box of six sponges, No. 7871

packing for gynaecologic and rectal surgery

Sterile Pack, size 6 cm
40 x 6 cm
box of six sponges, No. 7874

packing cavities – obliterating dead space

Sterile Sponge, size 200
80 x 250 x 10 mm
box of six sponges, No. 7862

for general surgery

Sterile Sponge, size 100
80 x 125 x 10 mm
box of six sponges, No. 7859

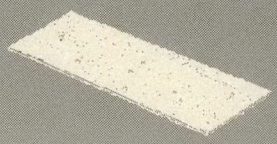
for general surgery

Sterile Sponge, size 50
80 x 62.5 x 10 mm
box of four sponges, No. 7858

specially prepared for dry application and emergency haemostasis

Sterile Compressed Sponge
size 100
12.5 x 8 cm
box of six sponges, No. 7865

for general and neurological surgery



Sterile Sponge, size 12–3 mm
20 x 60 x 3 mm
box of four sponges, No. 7852

for general and neurological surgery

Sterile Sponge, size 12–7 mm
20 x 60 x 7 mm
box of four sponges, No. 7853
jar of four sponges, No. 7854

promote healing in chronic leg ulcer

Sterile Powder
jar containing 1 g, No. 7876

non-haemostatic for ocular surgery

Ophthalmic Sterile Gelfilm
25 x 50 mm
box of 6, No. 7844

Precautions

Gelfoam and Gelfilm are simple to use, and with conscientious observance of certain precautions satisfactory results may generally be expected where their use is indicated.

1. Gelfoam should be used discriminately in arterial bleeding because of the intra-arterial pressure. It is advisable to suture and reinforce where possible.
2. Although Gelfoam generally serves its purpose well in the presence of haemorrhagic blood dyscrasias, it should not be relied upon as the sole method of haemostasis in such conditions.
3. Gelfoam should not be used to stop menstrual bleeding. In postpartum and menorrhagic bleeding it serves only as a temporary vaginal tampon.
4. Gelfoam must be in snug contact with the bleeding surface in order to be effective.
5. Use Gelfoam as sparingly as possible in order to minimise the amount of implanted foreign material.
6. Do not overfill cavities with Gelfoam.
7. Do not use Gelfoam in grossly contaminated wounds which are so deep that drainage is interfered with. However, it may be used for temporary haemostasis in more superficial contaminated wounds, provided it is removed after it has served its haemostatic purpose.
8. Avoid prolonged exposure of Gelfoam to contaminated air.

Detailed information available on request.

CE 7734.3

Upjohn

patients we have assigned them, retrospectively, to one of four categories: (1) patients who never had a colostomy; (2) patients who had a prophylactic colostomy without evidence of obstruction (at laparotomy the tumour was thought to be inoperable and a colostomy was done); (3) patients who underwent colostomy either during or within 3 months of irradiation; and (4) patients who had a colostomy because of total obstruction.

Using an actuarial method of calculation we found the 5-year survival rates for these four categories to be, respectively, 45%, 26%, 0% and 0% (no patient in category 4 survived 2 years).

The results for patients in category 1, who are comparable to operable cases, are not dissimilar to the best surgical results. Certainly this pilot experience suggests the curability of rectal cancer by irradiation.

Preoperative Irradiation

The results of the Toronto trial of preoperative irradiation in operable rectal cancer have already been reported in this Journal.[1] Suffice it to say that in cases staged as Dukes' C[2] there was a statistically significant improvement in survival after a single dose of 500 rads delivered a few hours before surgery. This approach could easily be used for all colorectal cancers, with appropriate modification in radiation technique.

Postoperative Irradiation

This is a situation that I believe is still sub judice. While the recurrence rates for Dukes' B_2 and C lesions are high, particularly if the line of resection is less than 4.0 cm distal to the lesion, the place of postoperative irradiation is not clear. The risks of irradiation-induced small-bowel complications must be weighed against the benefits, if the classical high doses are used.

Irradiation for recurrence after the Miles' operation will alleviate pain in about 80% of patients, but as a rule the relief is short-lived. Patients with the "phantom rectum" syndrome should be treated on the basis of symptoms without waiting for proof.

Admittedly radiation oncologists are neophytes in the application of this modality to malignant tumours of the gastrointestinal tract and have much to learn. For instance, the classical 5 days a week treatment protocol may not be the best way of irradiating patients with colorectal cancer. In a pilot study we have been impressed with a fractionation regimen of 500 rads every 2 weeks to a total of 3000 rads; this afforded appreciable palliation and about 50% tumour regression. This study is at an early stage but merits further scrutiny. Perhaps the principles of management of laryngeal cancer can be applied to rectal cancer, that is, irradiation in doses that are tolerable and not excessive should be administered and surgery should be used subsequently for salvage.

References

1. RIDER WD, PALMER JA, MAHONEY LJ, et al: Preoperative irradiation in operable cancer of the rectum: report of the Toronto trial. *Can J Surg* 20: 335, 1977
2. DUKES CE: Classification of cancer of the rectum. *J Pathol* 35: 323, 1932

6. Chemotherapy of Colorectal Cancer

D.J. KLAASSEN, MD, FRCS[C]*

Although considerable research effort has been expended to improve the drug treatment of colorectal cancer, progress has been slow. 5-fluorouracil (5-FU) is still the agent of choice and no other drug or combination of drugs has been found superior. When combined with radiation therapy 5-FU is superior to irradiation alone in the treatment of localized carcinoma of the rectum. When used as an adjuvant in the management of patients with a poor prognosis after definitive surgical resection, 5-FU has not improved survival or delayed the time to recurrence. Further controlled trials are indicated to find new agents or modalities of therapy to improve these results.

Bien qu'un effort de recherche considérable ait été consacré à l'amélioration de la chimiothérapie du cancer colorectal, les progrès ont été lents à venir. Le 5-fluorouracil (5-FU) demeure l'agent de choix et aucun autre médicament ou association de médicaments ne lui a été supérieur. En association avec la radiothérapie, le 5-FU est supérieur à l'irradiation seule dans le traitement du carcinome localisé du rectum. Employé comme traitement d'appoint chez les patients ayant un pronostic réservé après une résection chirurgicale définitive, le 5-FU n'a pas amélioré la survie ou retardé l'apparition des récidives. De nouvelles études contrôlées sont indiquées afin de trouver de nouveaux médicaments ou de nouveaux modes de traitement destinés à améliorer ces résultats.

Presented at the Canadian Oncology Society symposium on colorectal cancer, held at the annual meeting of the Royal College of Physicians and Surgeons of Canada, Toronto, Ont., Jan. 27, 1977

**Senior medical oncologist, Ontario Cancer Foundation, Ottawa clinic and chief, division of medical oncology, Ottawa Civic Hospital; assistant professor of medicine, University of Ottawa, Ottawa, Ont.*

Reprint requests to: Dr. D.J. Klaassen, Cancer clinic, Ottawa Civic Hospital, 1053 Carling Ave., Ottawa, Ont. K1Y 4E9

Chemotherapy should have a major role in the treatment of colorectal cancer for the following reasons: aside from skin cancer, colorectal cancer is the commonest form of malignant disease when men and women are considered together, and is the second commonest cause of death from such disease, being exceeded only by lung cancer in men and breast cancer in women. Also, surgery and radiation therapy have not changed cure rates over the past 20 years and the 5-year survival rate continues at approximately 45%. Therefore, 55% of patients could benefit from systemic therapy. The mean duration of life from time of proven unresectability or metastasis is 9.5 months (median, 7 months), 50%

of patients dying of complications of local recurrence and 50% dying of distant metastases.[1-3]

Unfortunately, colorectal cancer has proven exceptionally resistant to chemotherapeutic agents. Virtually every chemotherapeutic agent now available has had extensive trials in this disease and only a few drugs are active. They are listed in Table I, in descending order of effectiveness.[3,4] It can be seen that the antimetabolites with 5-fluorouracil (5-FU) and 5-fluorodeoxyuridine (5-FUDR) are the most active as a class, followed by the nitrosoureas, mitomycin C, then the alkylating agents, dimethyl-triazeno-imidazole carboxamide (DTIC) and the new agent 1,2-bis(3,5-dioxopiperazin-1-yl) propone (ICRF-159). Of the new agents being tested the most promising is fluorinated pyrimidine (Ftorafur). It is apparent that no drug is particularly good and obviously new agents are desperately needed.

5-FU has been extensively evaluated as to the best schedule and route of administration (Table II).[3,5] At present the standard 5-day loading course by push injection is still the best for induction. For maintenance therapy there is little to choose between the 5-day course once a month and a weekly injection. Oral administration has been found unreliable because of erratic absorption. Two studies, one by the Western Cancer Study Group[5] and the other by the Mayo Clinic,[6] have shown that, although induction rates may be the same as with the intravenous route, with the oral route the length of remission is substantially shorter. Most authorities now recommend the intravenous route except possibly for patients with liver metastases because of portal absorption of the drug. Hepatic artery infusion produces higher regression rates and slightly longer remissions. However, these advantages are at the cost of increased morbidity, time in hospital and technical difficulties, which make the route unattractive compared with standard intravenous administration. Therefore hepatic artery infusion is now used only in special institutions, usually when systemic therapy has failed.

Patients who respond to 5-FU do have an improved length of survival compared with nonresponders and untreated controls as shown in Figs. 1 and 2.[7] However, when all patients treated by 5-FU are considered together and compared with untreated controls, there is no evidence of improved survival, which is not surprising considering the low level of response to this drug. Younger patients and patients with slowly growing tumours have a higher response rate. Patients with lung metastases have a lower response rate than patients with metastases in other areas have, as shown in Table III.[1]

Combination chemotherapy has also been disappointing. Many combinations

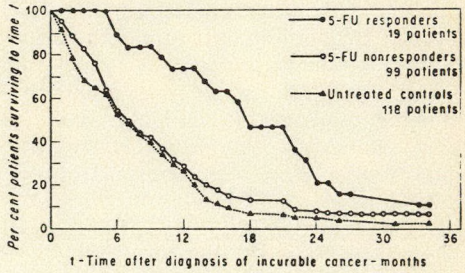


FIG. 1—Comparison of survival in responders and nonresponders in group of patients treated with 5-fluorouracil (5-FU) at Mayo Clinic and historical untreated control group of patients. Reproduced by permission from Moertel CG, Reitemeier RJ: *Advanced Gastrointestinal Cancer,* **New York, Har-Row, 1969.**

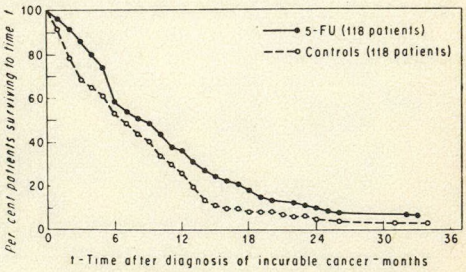


FIG. 2—Survival of all patients treated with 5-FU compared to matched historical untreated control group at Mayo Clinic. Reproduced by permission from Moertel CG, Reitemeier RJ: *Advanced Gastrointestinal Cancer,* **New York, Har-Row, 1969, p 132.**

Table I—Active Single Chemotherapeutic Agents[3]

Drug	No. of patients treated/ no. collected	Response rates, %	Duration of survival, mo		
			Median	Mean	Range
5-fluorouracil (5-FU) (5-fluorodeoxyuridine)	454/2107 (144/617)	21 (23)	5 (6)	7.3 (9.6)	2–25.5 (2–35.5)
Methyl-cyclohexyl-chloroethyl-nitrosourea (MeCCNU)	12/77	15	4.0	—	—
Bischloroethyl-nitrosourea	15/104	14	2	4.8	2–7.5
Mitomycin C	25/218	16	2	2.3	2–4
Cyclohexyl-chloroethyl-nitrosourea	7/75	10	4.5	5.0	2–9
Cyclophosphamide, Mayo Clinic[4]	24/89 (2/25)	27 (8)	—	—	—
Methotrexate, Mayo Clinic[4]	19/111 (2/38)	17 (5)	—	—	—
Melphalan	19/110	17	—	—	—
Hexamethylmelamine	10/86	11.5	—	—	—
Dimethyl-triazeno-imidazole-carboxamide (DTIC), Mayo Clinic[4]	8/71 (0/17)	11 (0)	—	—	—
1,2-bis(3,5-dioxopiperazin-1-yl) propone (ICRF-159), Mayo Clinic[4]	3/25	12	—	—	—

Table II—Results of 5-FU Administration[3]

Route schedule (collected series from literature)	No. of patients receiving drug/ total no. of patients	Response rate, %	Survival, mo
Intravenous, standard loading dose	257/1355	19	5–6
Intravenous, standard loading dose + weekly maintenance	52/134	39	5–6
Intravenous, weekly	42/197	21	5–6
Intravenous, 5-d loading	68/227	30	5–6
8–24-h infusion	18/106	17	5–6
Oral (Mayo Clinic[5])	17/88	19	2
Hepatic infusion	190/381	50	8

Table III—Response of Patients with Metastases to Administration of 5-FU*

Site of indicator lesion	No. of patients treated	Objective regressions, %
Liver	118	24†
Lungs	78	6.4†
Abdomen	34	32†
Cutaneous and subcutaneous	31	16
Peripheral nodes	8	25
Other	8	25

*Reproduced by permission from Moertel CG.[1]
†$P < 0.01$.

have been evaluated and Table IV lists only the well-documented studies, which show that combination chemotherapy is better than treatment with 5-FU alone.[8-10] In these studies, methyl-cyclohexyl-chloroethyl-nitrosourea (MeCCNU) combined with 5-FU appeared to produce higher rates of remission than 5-FU alone. Unfortunately, the length of remission produced was no better than with single agents. Combination chemotherapy does produce more morbidity. More recent studies have failed to confirm these results and it now appears that the combination of 5-FU and MeCCNU is no better than 5-FU alone.[11,12]

Chemotherapeutic agents, particularly 5-FU, have been used in combination with other modalities such as surgery, irradiation and immunotherapy to treat colorectal cancer.

The value of chemoimmunotherapy is being assessed. Preliminary studies from the M.D. Anderson Hospital[13] and South West Oncology Group[10] have shown that 5-FU plus bacille Calmette Guérin (BCG) may produce a longer disease-free period with increased survival in patients with a poor prognosis when used as an adjuvant to surgery (Table V). All these studies, however, need to be confirmed by randomized controlled trials from other institutions and groups.

When 5-FU is combined with radiation therapy, there is a modest improvement in length of remission and survival compared with results of radiation therapy alone in patients with locally inoperable or recurrent disease. This has been shown by a single study from the Mayo Clinic (Table VI)[1] and needs to be confirmed by other studies that are in progress at present.

5-FU and 5-FUDR have been extensively evaluated as adjuvants to surgery in patients classified as having Dukes' stage B_2 or stage C disease. Unfortunately, all the large randomized controlled clinical trials have shown no benefit from 5-FU with respect to survival or disease-free life.[14] Later studies using new combination regimens and multimodality therapy may change this picture.

To summarize:

1. 5-fluorouracil (5-FU) is still the best single chemotherapeutic agent for colorectal cancer. However, response rates are low and new drugs are desperately needed.

2. There are no drug combinations that are superior to 5-FU alone either with respect to percent remission or duration of remission.

3. Chemoimmunotherapy may be better than chemotherapy alone, especially in the adjuvant setting, but further controlled trials are needed.

4. 5-FU combined with irradiation gives slightly better results than irradiation alone.

5. 5-FU has not prolonged the disease-free interval or survival when used as adjuvant therapy after surgery in patients with a poor prognosis. Further controlled trials with new agents and various combinations of drugs and therapies are in progress.

Table IV—Response and Duration of Survival in Patients with Colorectal Cancer Treated by Combination Chemotherapy

Combination	No. of patients treated/ total no. of patients	Response rate, %	Duration of survival, mo
5-FU + MeCCNU[10]	38/128	30	Not reported
5-FU + MeCCNU + vincristine (VCR)[8,9]	17/39	43	Not reported
	16/45	37	5
5-FU + MeCCNU + DTIC + VCR[9]	12/28	43	4.5

Table V—Chemoimmunotherapy in Colorectal Cancer (Dukes' Stage C)[13]

Adjuvant regimen	No. of patients	No. of relapses	No. of deaths	Prolongation of tumour-free interval	Survival
Historical controls	73	48	41		
Bacille Calmette Guérin (BCG) (at 20 mo)	33	6	2	P = 0.03 vs control	P = 0.05 vs control
BCG + 5-FU (100 mg/m², orally *qid* × 5, *q4wk* (at 15 mo)	50	8	0	P = 0.03 control P = 0.42 BCG vs 5-FU + BCG	P = 0.01 vs control P = 0.05 BCG vs 5-FU + BCG

Table VI—Controlled Trial of 5-FU and Radiotherapy in Colorectal Cancer[1]

Regimen	No. of patients	Response rate, %	Median duration of remission, mo		Median survival, mo	
5-FU 15 mg/kg daily × 3 + 4000 rads	32	50 (symptomatic)	10	P < 0.01	23	P < 0.05
Saline + 4000 rads	33	50 (symptomatic)	5		16.5	

References

1. MOERTEL CG: Large bowel cancer, Section XXIV-12, in *Cancer Medicine,* HOLLAND JF, FREI E (eds), Philadelphia, Lea & Febiger, 1973, pp 1591-1627
2. Colon cancer. *Semin Oncol* 3: 331, Dec. 1976
3. CARTER SK, FRIEDMAN M: Integration of chemotherapy into combined modality treatment of solid tumours—large bowel carcinoma. *Cancer Treat Rev* 1: 111, 1974
4. MOERTEL C: Chemotherapy of large bowel cancer. *Cancer* 36 (suppl): 674, 1975
5. HAHN R, MOERTEL CG, SCHUTT AJ, et al: A controlled comparison of intensive course 5 fluorouracil by oral versus intravenous route in colorectal carcinoma (abstr 830). *Proc Am Assoc Cancer Res* 15: 191, 1974
6. BATEMAN JR, IRWIN L, PUGH R, et al: Comparison of intravenous and oral administration of 5 fluorouracil for colorectal cancer (abstr 1087). *Proc Am Assoc Cancer Res* 16: 242, 1975
7. MOERTEL CG, REITEMEIER RJ: *Advanced Gastrointestinal Cancer. Clinical Management and Chemotherapy,* New York, Har-Row, 1969, p 132
8. MOERTEL CG, SCHUTT AJ, HAHN RG, et al: Therapy of advanced colorectal cancer with a combination of 5-fluorouracil, methyl-1,3-cis(2-chloroethyl) -1-nitrosourea, and vincristine. *Cancer Inst* 54: 69, 1975
9. FALKSON G, FALKSON HC: Fluorouracil, methyl-CCNU and vincristine in cancer of the colon. *Cancer* 38: 1468, 1976
10. BAKER LH, MATTER R, TALLEY R, et al: 5 fluorouracil versus 5 fluorouracil and methyl CCNU in gastrointestinal cancer. A phase III study of the South West Oncology Group (abstr 1034). *Proc Am Assoc Cancer Res* 16: 229, 1975
11. LOKICH J, SKARIN A, MAYER R, et al: Lack of effectiveness of combined 5 fluorouracil and methyl CCNU therapy in advanced colorectal cancer (abstr). *Proc Am Soc Clin Oncol* 1978 (in press)
12. ENGSTROM P, DOUGLASS H, MCINTYRE J, et al: Combination chemotherapy of advanced bowel cancer (abstr). Ibid
13. GUTTERMAN JU, MAVLIGIT GM, BLUMENSHEIN G, et al: Immunotherapy of human solid tumors with bacillus Calmette-Guérin: prolongation of disease-free interval and survival in malignant melanoma, breast, and colorectal cancer. *Ann NY Acad Sci* 277: 135, Sept. 20, 1976
14. MOERTEL CG: Fluorouracil as an adjuvant to colorectal cancer surgery; the breakthrough that never was (C). *JAMA* 236: 1935, 1976

7. Discussion on Management of Colorectal Cancer

Panelists: P. GOLD, D.J. KLAASSEN, S.A. LOCALIO, A.B. MILLER, B.C. MORSON AND W.D. RIDER

At the close of both sessions of the symposium members of the audience were invited to submit questions. These were assigned to the various speakers. A number of representative questions and answers appear below.

Question: What further treatment is indicated when, after the local excision of a carcinoma of the rectum, the pathologist recognizes venous or lymphatic invasion?

Answer (Dr. Morson): So far I have seen no evidence that the observation of lymphatic invasion in locally excised specimens in any way changes the prognosis. It may, of course, be difficult to be sure on histologic grounds that lymphatics are invaded. In regard to venous invasion, there is not as much information available as we really need. Our experience suggests that venous invasion limited to the submucosa does not alter the prognosis except in the exceptional case. On the other hand, spread within the veins of the extramural tissues is associated with a very poor outlook. So a distinction must be made between submucosal venous spread and extramural venous spread.

Question: Does carcinoma arise in the hamartomas of the Peutz-Jeghers syndrome?

Answer (Dr. Morson): The Peutz-Jeghers syndrome is rare and any contribution it makes to the totality of cancer of the colon and rectum must be exceedingly minute. Cancer does occur in this syndrome but it is rare.

Question: May we have some comment on the distribution of the villous adenoma throughout the rectum and colon and its relation to carcinoma?

Answer (Dr. Morson): The modern methods of investigation of the colon with colonoscopy and air contrast barium enema have made it clear that villous adenomas are found in the proximal part of the colon and more frequently than was once believed. The question of distribution is further confused because many surgeons have called large sessile tumours "villous" without reserving that term for those that have the microscopic appearance of the villous adenoma. It is now well accepted that some tubular adenomas have a flat or sessile gross appearance. It is therefore somewhat dangerous to rely on the older literature.

Question: Are there any other immunologic indicators such as the concentration of α_1-fetoprotein that have any value in either the diagnosis or postoperative surveillance of patients with colorectal cancer?

Answer (Dr. Gold): Measurement of α_1-fetoprotein is not very useful in the postoperative surveillance of patients with colorectal cancers. It may occasionally be of help, however, in patients with gastric cancer. A number of other markers of colorectal cancer are being investigated at present. On the whole, if one uses a variety of markers, it may be possible to find cancers at an earlier stage and perhaps achieve better cure rates than by employing any one marker alone.

Question: Is there any development of a holistic theory of the etiology of carcinoma of the breast and colon?

Answer (Dr. Miller): It is possible that there are two different phases of carcinogenesis. The rapid change in the frequency of colonic cancer that occurs on migration does not occur with breast cancer. This may mean that the nutritional channels responsible for breast cancer operate only during adolescence or early in life and therefore require a generation for dietary factors to exert their effect. Nutritional factors may be responsible for initiation in breast carcinogenesis and for potentiation in colorectal carcinogenesis.

Question: Are there any firm data that methyl-cyclohexyl-chlorethyl-nitrosourea added to 5-fluorouracil as adjuvant therapy is of any value?

Answer (Dr. Klaassen): None of the trials using that combination are finished yet, not even preliminary data are available.

Question: Was radiation treatment to a dose of 500 rads given to any patients who had anterior or abdominosacral resection?

Answer (Dr. Rider): It was given to 40 who had anterior resection but to none who had abdominosacral resection.

Question: Was it followed by any morbidity?

Answer (Dr. Rider): No.

Question: Do you favour 500 rads over the higher dose of 4500 rads directed over a larger field and given over a longer period of time?

Answer (Dr. Rider): The results of trials using 500, 2000, or 4500 rads have all been the same. Therefore, it does not matter as long as a dose of 500 rads or more is given. The 500-rad dose was based on an animal experiment.

Question: What is the significance of that time interval? Why insist that it be given within 8 hours of surgery? What happens when the effect diminishes after 8 hours?

Answer (Dr. Rider): I don't know. But in the experimental work the benefit of the radiation wore off if the operation was done more than 8 hours afterwards.

Question: What was the rate of leakage after abdominosacral resection?

Answer (Dr. Localio): In our first 50 cases we had a 37.5% rate. In the second 50 cases we had only a 4% rate. The leaks occurred in males in the younger age group, a group of patients in whom the operation is technically difficult. We now do defunctioning colostomies in males under 65 years of age. This is a manifestation of the difficulty of the operation in males as compared with females who have a roomier pelvis.

Question: Dr. Rider, are you at present advising patients with operable carcinoma of the rectum, who are simply seeking your opinion, to have radiotherapy as the primary method of treatment?

Answer (Dr. Rider): Yes, but I don't often get the chance.

Question: Dr. Localio, would you comment?

Answer (Dr. Localio): We are now adding radiation therapy for patients whose cancer is classified as Dukes' stage C

Conducted at the Canadian Oncology Society symposium on colorectal cancer, held at the annual meeting of the Royal College of Physicians and Surgeons of Canada, Toronto, Ont., Jan. 27, 1977

Reprint requests to: Editorial office, Canadian Journal of Surgery, PO Box 8650, Ottawa, Ont. K1G 0G8

because we are not happy with our previous salvage rate. I must make one point. I do not think that one can tell just by putting a finger in the rectum whether a tumour is fixed and inoperable. This feature is much better recognized at operation. Moreover, sometimes the fixation is due to inflammatory disease, not to cancer.

Question: Dr. Rider, you tried to correlate survival with whether or not the patient had a colostomy. Do you use that information to determine whether or not colostomy is used during the course of therapy if radiotherapy alone is given? Is it necessary to divert the fecal stream during the treatment?

Answer (Dr. Rider): There is no good reason to do a prophylactic colostomy in a patient who is not obstructed. None of our patients had the colostomy closed later. Some patients do become obstructed during treatment and require emergency colostomy.

Question: Dr. Localio, would you comment on continence after abdominosacral resection and on the length of rectal stump necessary to ensure it?

Answer (Dr. Localio): All our patients have sphincteric continence. In the immediate postoperative period most patients have some problem of reservoir continence. This is manifested by frequent small motions, but without incontinence, without losing stool or the ability to retain gas. The reservoir function improves after a few weeks. On the basis of our experience it would appear that 3 cm of rectal mucosa is sufficient to preserve continence if the anal mucosa and sphincters are intact.

Question: Dr. Localio, what are the local recurrence rates for the abdominosacral and abdominoperineal resections in your series?

Answer (Dr. Localio): Recurrence rates for abdominoperineal resection often can only be estimated because of the "phantom rectum" syndrome and cannot be proved. Recurrences are not so much local as pelvic and they occur mostly in patients belonging to Dukes' C and B_2 categories. The local recurrence rate for both procedures is in the vicinity of 20% to 30% for Dukes' stage C cases over a 5-year period. Thus if there is a 60% survival rate after abdominosacral resection, half of the patients die of distant metastases and half of these show local metastases before their distant metastases become evident.

Question: What do you believe should be the radiation field for a patient in Dukes' stage B_2 or C?

Answer (Dr. Localio): It is our practice to include most of the pelvis in the patients belonging to Dukes' stage C.

Importance of Mixed Venous Oxygen Saturation in the Care of Critically Ill Patients

A.G. DE LA ROCHA, MD, FRCS[C],* J.F. EDMONDS, MB, FRCP[C]† W.G. WILLIAMS, MD, FRCS[C],‡ C. POIRIER, RN AND G.A. TRUSLER, MD, FRCS[C]§

The relation between mixed venous oxygen saturation and cardiac index was determined in 11 children who underwent surgical treatment for congenital heart disease. The correlation between these two variables was found to be reliable ($r = 0.78$, $P = 0.001$). The simple determination of mixed venous oxygen saturation provides a useful estimate of myocardial performance, particularly when sophisticated equipment for measuring cardiac output is not available.

La relation entre la saturation veineuse mixte d'oxygène et l'index cardiaque a été déterminée chez 11 enfants qui ont subit un traitement chirurgical pour maladie cardiaque congénitale. La corrélation entre ces deux variables s'est avérée fiable ($r = 0.78$, $P = 0.001$). La simple détermination de la saturation veineuse mixte d'oxygène offre une appréciation utile de la performance myocardique, particulièrement lorsqu'un équipement sophistiqué de mesure du débit cardiaque n'est pas disponible.

From the department of cardiovascular surgery, The Hospital for Sick Children and University of Toronto, Toronto, Ont.

**Formerly senior resident, department of cardiovascular surgery, The Hospital for Sick Children, University of Toronto. Currently staff surgeon, department of cardiothoracic and vascular surgery, St. Joseph's Hospital, McMaster University, Hamilton, Ont.*

†Deputy director, intensive care unit, The Hospital for Sick Children, Toronto

‡Staff surgeon, department of cardiovascular surgery, The Hospital for Sick Children, Toronto

§Associate professor and head, department of cardiovascular surgery, The Hospital for Sick Children, Toronto

Reprint requests to: Dr. A.G. de la Rocha, 66 Charlton Ave. W, Hamilton, Ont. L8P 2C1

The quality of care for the critically ill patient improved considerably after Cournand and colleagues[1] instituted the practice of obtaining hemodynamic measurements, including cardiac output (CO), in patients in shock. In large medical centres the availability of sophisticated equipment permits minute-by-minute measurement of hemodynamic values, thus providing the clinician with a better understanding of the rapidly changing physiology of the critically ill patient. However, these measurements have not been made routinely in the majority of community hospitals because of the cumbersome techniques required.

Part of our postoperative assessment in patients who have had surgical repair for congenital heart disease is the determination of mixed venous oxygen saturation (Svo_2), estimations of cardiac index (CI), and continuous measurement of central venous pressure (CVP), pulmonary arterial pressure, left atrial pressure and radial artery pressure in addition to the electrical display of lead II of the electrocardiogram. It occurred to us that these data could be useful for the clinician who lacks the resources to measure cardiac output. A flow-directed balloon-tipped catheter positioned in a branch of the pulmonary artery for recording pulmonary capillary wedge pressure has been widely used since its value was reported by Swan and associates.[2] Through this catheter samples of mixed venous blood can be withdrawn for measuring oxygen tension and saturation. These parameters, as we report below, accurately reflect the CI.

Material and Methods

Eleven patients form the basis of this report (Table I). Of the seven who were infants, an operation for ventricular septal defect (VSD) was performed in five, for a defect of atrial septum (ASD) (primum) in one, and for recurrent pulmonary valvular stenosis in one. Their body weights ranged from 3.5 to 9.4 kg. The operations were done under conditions of deep hypothermia and circulatory arrest.

In four children, aged from 6 to 11 years, the operation was for total repair of ASD (secundum) and pulmonary stenosis, for membranous VSD and ASD secundum, for subaortic fibromuscular stenosis, or for tetralogy of Fallot.

Table I—Particulars of Patients Studied

Patient no.	Diagnosis	Age	Sex	Weight, kg
1	VSD	13 mo	M	8.3
2	VSD + PDA	4 mo	M	3.5
3	VSD	19 mo	F	9.4
4	VSD + PDA	7 mo	M	6.1
5	VSD	13 mo	F	5.7
6	ASD-1	6 mo	F	4.0
7	PS (recurrent)	11 mo	M	7.2
8	ASD-2 + PS	11 yr	F	37.0
9	VSD + ASD-2	6 yr	M	18.5
10	Subaortic fibromuscular stenosis	8 yr	M	23.0
11	Tetralogy of Fallot	10 yr	F	35.0

VSD = ventricular septal defect; ASD = atrial septal defect; PDA = patient ductus arteriosus; PS = pulmonary stenosis.

Body weights ranged from 18 to 37 kg. The operations were performed using cardiopulmonary bypass and under moderate systemic hypothermia.

A CVP line and a radial artery pressure line were introduced percutaneously soon after induction of anesthesia. After completion of the surgical repair and before the sternotomy incision was closed, a small polyethylene catheter (Intracath 19GA — 12″; Deseret Pharmaceutical Co. Inc., Sandy, UT) was inserted into the pulmonary artery through the anterior wall of the right ventricle and brought out through the chest wall. The catheter was sutured to the epicardium and to the skin to prevent dislodgement. A similar catheter was introduced into the left atrium through the right superior pulmonary vein.

The position of the catheters was verified by a chest roentgenogram taken in the operating room before moving the patient to the intensive care unit (ICU).

A plastic stopcock was interposed in the manometer line to allow for sampling of blood. The lines were kept patent by means of a constant low-flow infusion (1 to 2 mL/h) of 5% dextrose in water plus 0.2% normal saline solution and heparin (500 IU/L).

All pressure lines were connected to Hewlett-Packard (Palo Alto, CA) pressure transducers, models 267 and 268A for high- and low-pressure systems, respectively. A constant display in digital read-out and curve wave form was obtained of all measurements.

Cardiac index was estimated on arrival in the ICU and 6 and 24 hours postoperatively. More determinations were done if necessary, depending on the circumstances of each case. A specialized analogue cardiac output computer (Cor 100-A cardiac output computer; Waters Instruments, Inc., Rochester, MN) was used to perform these measurements. This computer is designed to display digitally the cardiac output from the indicator dilution curves. The computer obtains its electrical input signals from the indicator dilution amplifier and integrates the area under the dilution curve from its starting point to the downslope side at 75% of the peak. From this 75% of the peak, the computer analyses the assumed exponential decay of the curve to 50% peak height and extrapolates the final part of the curve.

Tricarbocyanine dye (Cardio-Green; Hynson, Westcott and Dunning Inc., Baltimore, MD) in a dose of 1.25 to 2.5 mg was rapidly injected as a bolus into the CVP line, pulmonary arterial line or left atrial line while blood was being withdrawn from the radial artery through a densitometer cuvette (Cor 100-A densitometer; Waters Instruments Inc.) consisting of two cell optical systems. The total dose of dye injected was kept below the recommended limit of 2 mg/kg. The indicator dilution curve was recorded on a single channel recorder (Cor 100-A recorder; Waters Instruments Inc.).

Three to five dye dilution curves were obtained in each instance. The mean of their values served to obtain a CO figure. CO was divided by the body surface area in order to obtain the CI (L/min·m²).

Arterial blood gases were routinely obtained every 4 hours or more frequently as indicated. Mixed venous blood was sampled from the pulmonary artery every hour, and 10 minutes before and after the CI was determined. Heparinized syringes were used, employing a strict anaerobic technique. All samples were kept in ice to diminish oxygen consumption by red blood cells.

Blood-gas determinations were performed in an automatic pH/blood-gas machine (Corning 175 automatic pH/blood-gas system, Corning Medical, Corning Glass Works, Medfield, MA) which determined partial pressure of oxygen (Po_2) with the Clark electrode. Oxygen from the blood diffuses across a polypropylene membrane; the platinum electrode (anode) causes breakdown of oxygen molecules, creating a flow of current to the silver electrode (cathode). The higher the Po_2, the greater the current flow.

All results were fed into a calculator (Olivetti Underwood Programma Calculator 101) with computerized memory to obtain the mean of the observations, standard deviations and standard errors. To calculate the correlation between CI and Svo_2 a program of coefficient of linear correlation was used, and to ascertain the confidence limits of the population parameters, Student's *t*-test was used.

Results

In Fig. 1 individual Svo_2 observations are plotted against CI. All Svo_2 values of less than 65% corresponded to a CI of less than 2.5 L/min·m² except in one instance in patient no. 5. There was a statistically significant correlation among these values ($r = 0.78$, $P < 0.001$).

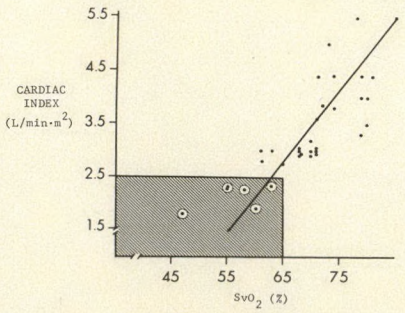


FIG. 1—Significant correlation ($r = 0.78$, $P < 0.001$) between mixed venous oxygen saturation and cardiac index.

A similar value ($r = 0.67$, $P < 0.001$) was found when the Svo_2 observations were correlated to CI in 34 patients reported by Boyd and his group.[3] Similarly, Svo_2 values below 65% corresponded to a CI less than 2.5 L/min·m² except in six isolated determinations in which the CI was normal.

The hemodynamic data from three patients who postoperatively had a low cardiac output syndrome (group 1) are presented in Table II. There were no deaths in this group. All were treated with inotropic agents which produced

Table II—Group 1 Patients with Postoperative Low Cardiac Output Syndrome

Patient no.	Diagnosis	Cardiac index, L/min·m²	Svo_2, %
2	VSD + PDA	2.75	65
		2.33	63
		2.90	68
		1.88	60
5	VSD	1.85	47
		2.25	58
		2.79	61
6	ASD-1	3.0	68
		2.3	55
		2.3	53
		3.0	71
		3.27	70

Table III—Group 2 Patients with Normal Postoperative Period

Patient no.	Diagnosis	Cardiac index, L/min·m²	Svo_2, %
1	VSD	5.0	73
		4.4	71
3	VSD	5.52	78
		3.84	75
		3.58	71
4	VSD + PDA	3.3	79
		4.4	74
7	PS (recurrent)	2.99	68
		3.17	63
8	ASD-2 + PS	3.46	80
		4.13	79
		4.16	80
9	VSD + ASD-2	3.0	70
		3.85	72
10	Subaortic fibromuscular stenosis	4.4	79
		4.4	81
11	Tetralogy of Fallot	2.98	71
		2.97	71

a good effect on the values of $S\bar{v}o_2$ and CI. Patient no. 2 showed transient improvement soon after inotropic support was begun, but when the dosage of the inotropic agent was increased a low $S\bar{v}o_2$ and CI ensued. This was associated with a sharp increase in the pulmonary arteriolar resistances. $S\bar{v}o_2$ and CI correlated well in following the response to therapy in these patients ($r = 0.86$, $P < 0.05$).

The hemodynamic data from the patients who had an uncomplicated postoperative period (group 2) are set forth in Table III. There was only one $S\bar{v}o_2$ value below 65% in the presence of a normal CI; the arteriovenous oxygen difference was slightly widened and the pulmonary and systemic resistances were normal. The only explanation that can be offered for this anomaly is that the patient's temperature was elevated to 39.5°C at the time the values were determined.

In Table IV the $S\bar{v}o_2$ and CI of groups 1 and 2 are compared.

Discussion

Our study confirms that serial determinations of $S\bar{v}o_2$ can be used as a guide in estimating the CI. From the data collected from patients having low cardiac output syndrome, it is evident that an $S\bar{v}o_2$ of less than 65% is indicative of inadequate myocardial function. The increment in $S\bar{v}o_2$ following inotropic treatment correlated well with the CI. A notable decrease in $S\bar{v}o_2$ was accompanied by a paradoxical depression in CI following changes in the dosage of the inotropic agent in patient no. 2.

Oxygen exchange at tissue level is determined basically by the metabolic rate, the rate of capillary blood flow and the microcirculatory perfusion. There is a 10% increase in oxygen consumption for each degree Celsius elevation in temperature above 37°C. The transit time of blood in the capillaries, together with the metabolic rate, will determine the amount of oxygen extracted from blood. The slower the rate at which blood circulates, the greater is the arteriovenous oxygen difference. Cardiac output is the major determinant of capillary flow rate and is therefore the major factor determining the oxygen content of venous blood.[4]

Table IV—Comparison of Groups 1 and 2

Group	Cardiac index, L/min·m²	$S\bar{v}o_2$, %
1	2.55	61.5
2	3.86	74.1
P value	<0.025	<0.025

The Fick formula, as at (1) below, is based on the above set of principles; if the formula is rearranged, as at (2), it becomes apparent that mixed venous oxygen content is directly related to arterial oxygen content and inversely related to the ratio of oxygen uptake peripherally, and cardiac output centrally.[5]

$$1.\quad \text{Cardiac output (mL/min)} = \frac{\text{oxygen uptake}}{\text{arteriovenous oxygen difference}}$$

$$2.\quad \text{Mixed venous oxygen content} = \frac{\text{arterial oxygen content} - \text{oyxgen uptake}}{\text{cardiac output}}$$

If we assume that the metabolic rate, pulmonary gas exchange and hemoglobin concentration remain stable, the arterial oxygen content will be constant and $S\bar{v}o_2$ will vary directly with the CO.

If we exclude patients in septic shock who, despite a high metabolic rate, have a characteristically narrowed arteriovenous oxygen difference as a result of decreased oxygen transport and utilization,[6] the average surgical patient, in a situation of low cardiac output secondary to a low intravascular volume, or pump failure, or both, will have a stable metabolic rate. In a normal flow state, metabolic activity is the major determinant of CO.[7]

Parr, Blackstone and Kirklin[8] studied 139 infants and children who underwent cardiac surgery for congenital heart disease and concluded that death from acute cardiac failure could be more reliably predicted using the CI and mixed venous oxygen tension ($P\bar{v}o_2$) (normal, 40 mm Hg = $S\bar{v}o_2$ 70%) together than by either value alone. A set of isobars, each representing a percentage of risk of death from acute cardiac failure, was constructed to correspond to simultaneous determinations of CI and $P\bar{v}o_2$. According to these authors, a patient with a CI of 1.8 and a $P\bar{v}o_2$ of 30 mm Hg (approximate $S\bar{v}o_2$ 60%) ran a risk of death from acute cardiac failure of less than 10%. In a patient with the same CI but a $P\bar{v}o_2$ of 20 mm Hg the risk was greater than 75%.

Some workers[9,10] have stated that $P\bar{v}o_2$ or $S\bar{v}o_2$ is of more clinical value than isolated determinations of cardiac output in managing the acutely ill patient.

We believe that $S\bar{v}o_2$ may predict within a matter of minutes a subsequent fall in CI to critical levels. Although we lack sufficient technical data to substantiate this statement, we have found it to be true in two cases not included in this report. However, from the data presented we are justified in concluding that $S\bar{v}o_2$ is a useful, practical means of estimating indirectly the CI in patients who are critically ill and that it correlates well with the response to therapy.

References

1. Cournand A, Riley RL, Bradley SE, et al: Studies of the circulation in clinical shock. *Surgery* 13: 964, 1943
2. Swan HJC, Ganz W, Forrester J, et al: Catheterization of the heart in man with use of a flow-directed balloon-tipped catheter. *N Engl J Med* 283: 447, 1970
3. Boyd AD, Tremblay RE, Spencer FC, et al: Estimation of cardiac output soon after intracardiac surgery with cardiopulmonary bypass. *Ann Surg* 150: 613, 1959
4. Shapiro BA: *Clinical Application of Blood Gases,* New York, Year Bk Med, 1973, pp 30-40
5. Theye RA, Tuohy GF: The value of venous oxygen levels during general anesthesia. *Anesthesiology* 26: 49, 1965
6. Duff JH, Groves AC, McLean APH, et al: Defective oxygen consumption in septic shock. *Surg Gynecol Obstet* 128: 1051, 1969
7. Finch CA, Lenfant C: Oxygen transport in man. *N Engl J Med* 286: 407, 1972
8. Parr GVS, Blackstone EH, Kirklin JW: Cardiac performance and mortality early after intracardiac surgery in infants and young children. *Circulation* 51, 867, 1975
9. Osborn JJ, Beaumont JO, Raison JC, et al: Measurement and monitoring of acutely ill patients by digital computer. *Surgery* 64: 1057, 1968
10. Benzing G 3d, Helmsworth JA, Schreiber JT, et al: Cardiac performance and oxygen consumption during intracardiac operations in children. *Ann Thorac Surg* 22: 176, 1976

BOOKS RECEIVED

continued from page 213

Cleft Craft. The Evolution of its Surgery. II. Bilateral and Rare Deformities. D. Ralph Millard, Jr. 922 pp. Illust. Little, Brown and Company, Inc., Boston, 1977. Price not stated. ISBN 0-316-57138-5.

Clinical Concepts of Neurological Disorders. Edited by James F. Toole. 294 pp. Illust. The Williams & Wilkins Company, Baltimore; Burns & MacEachern Limited, Don Mills, 1977. $26.35.

Clinical Neurosurgery. Proceedings of the Congress of Neurological Surgeons, New Orleans, Louisiana, 1976. Edited by Ellis B. Keener, Willis E. Brown, Jr., Peter W. Carmel and others. 670 pp. Illust. The Williams & Wilkins Company, Baltimore; Burns & MacEachern Limited, Don Mills, 1977. $40.25. ISBN 0-683-02010-2.

Comprehensive Arthroscopic Examination of the Knee. Lanny L. Johnson. 156 pp. Illust. The C.V. Mosby Company, Saint Louis, 1977. $51.25. ISBN 0-8016-2534-3.

continued on page 247

announcing

Nature and Management of Penetrating Head Injuries during the Civil War in Lebanon

FUAD SAMI HADDAD, MD, FRCS[C], FACS*

During the recent war in Lebanon, at one hospital one fifth of all casualty admissions were patients with skull injuries associated with penetrating brain damage. Wounds inflicted by high velocity missiles carried the greatest mortality. The patient's state of consciousness afforded the best guide to prognosis.

Craniotomy, when feasible, was found preferable to the accepted technique of craniectomy in the management of these cases. Thorough débridement and complete hemostasis are essential, and when these have been accomplished, deeply placed bony fragments may be left in situ with impunity. Traumatic aneurysms develop by no means rarely and therefore postoperative arteriography is advisable.

Durant la guerre qui s'est déroulée récemment au Liban, un cinquième des blessés hospitalisés dans un des hôpitaux, étaient des patients ayant subit des blessures craniennes associées à une lésion perforante du cerveau. Les blessures infligées par des projectiles à haute vélocité ont entraîné la plus forte mortalité. Le degré de conscience du patient a constitué le meilleur guide pour le pronostic.

Dans le traitement de ces patients la craniotomie, quand elle était possible, a été jugée préférable à la technique acceptée de craniectomie. Un débridement adéquat et une hémostase complète sont essentiels et quand ceux-ci ont été réalisés, les fragments osseux profondément enfoncés peuvent être laissés en place sans séquelle. Le développement d'un anévrisme traumatique n'est pas rare et l'artériographie postopératoire est donc à recommander.

Older men declare war. But it is youth that must fight and die. And it is youth who must inherit the tribulations, the sorrow and the triumphs that are the aftermath of war.

—Herbert Hoover

Fifteen years ago Dr. Penfield himself addressed the Middle East Medical Assembly in Beirut as the first orator of this named lecture. In his introduction he said, "It makes me feel a little posthumous to stand here and address you." Today it is my duty to deliver the first posthumous Wilder Penfield lecture. Although he is no more with us in body, his spirit permeates not only the Montreal Neurological Institute but also many other centres whose directors or instructional staff trained under this unique teacher.

Out of the turmoil in Lebanon a wide experience of war surgery in general and of brain injuries in particular has accumulated. It is this experience that I wish to share with you.

At the outbreak of the war Beirut had about 1 million inhabitants. The fighting broke out between the eastern and the western sections. The American University Medical Center is part of the university and is located in the western section about 720 m from the large hotels where some of the fiercest fighting took place. The Orient Hospital, one of the two centres where I practise, was in the line of fire between the Holiday Inn and the Murr Tower. From the outset it was eliminated as a hospital and later was pillaged and burned. The American University Medical Center together with four other major hospitals, the Berbir Medical Center, the Makassed General Hospital, the Arab University Hospital and the Beirut General Hospital, drained the casualties from the western section of the city and its outskirts. While all five hospitals had neurosurgeons, only three were active.

Our centre was soon turned into a field hospital, receiving seriously injured patients, as well as a base hospital receiving referrals from the other four major city hospitals and outlying field hospitals where no neurosurgery was available. The western section was isolated from the world. There was no air or sea traffic; land traffic was extremely difficult and supplies by this route were limited to a few essentials. Very rapidly we ran out of sheets, pillows, mattresses, gauze, bandages, important medications and other essential items. Early in the conflict we ran short of oxygen and anesthetic gases. On many occasions our anesthetists had to use ether and ambient air. Blood was often hard to obtain in spite of goodwill on the part of everybody. Many workers, nurses and doctors were stranded in the eastern section of the city and many others fled the country so that the effective staff quickly dwindled to about 30% of its original number. Many had to live on the premises because it was impossible for them to go home. In short, the load soared while the ability to deal with it shrank, thus increasing in rapid progression the hardships and responsibilities of those who remained. Dr. Sami Nassar, my neurosurgical colleague, and I were assisted by a very willing house staff of two to four residents who, in addition to working for the neurosurgical patients, had to attend to the orthopedic and plastic surgery cases, so that their average patient–day load was 175.

The casualties were often whisked in by truck or on armed jeeps while friends in the vehicle improvised sirens by firing their automatic high-powered rifles

---

Wilder Penfield lecture of the American University of Beirut, delivered at the Montreal Neurological Institute, Montreal, PQ, Oct. 29, 1976.

Supported by the Louise Massabky Fund.

**Chief neurosurgeon, Orient Hospital and clinical professor of neurosurgery, American University of Beirut, Lebanon*

Reprint requests to: Dr. F.S. Haddad, Clinical professor of neurosurgery, American University of Beirut, PO Box 113-6044, Beirut, Lebanon

in the air. The injured were dumped in the emergency rooms, often with no identification other than what they themselves could furnish. Then would start the tedious and painful work of sorting. Those awake were shouting for attention and, if they were accompanied, their attendants often threatened us with firearms. It was under such circumstances that the staff of the emergency rooms laboured night and day and cared for the 5250 casualties received during the period of this study. Those patients fit to be sent home received attention in the emergency rooms and were later discharged. They numbered 3607 (68.7% of the total).

Those who needed observation were either transferred to other local hospitals or to our medical centre. Those admitted to our centre numbered 1372 (26.1%). The 271 (5.2%) patients dead on arrival were sent to the morgue. The injured who needed surgery were wheeled immediately to the recovery room which was sealed from family and fighters. It was there that the patients having priority for admission to the operating rooms were selected. Usually those with chest injuries and cardiac tamponade received highest priority, then those with injuries to large blood vessels, and third in order were patients with head injuries.

If two patients with severe head injuries were admitted simultaneously, the patient with the better prognosis was operated on first. For example, a patient with a dilating pupil was attended to before one who already had bilateral dilated fixed pupils.

The limiting factor was the availability of staff. In one night 23 major operations were performed within 8 hours. At another time 13 craniotomies were done by a single surgeon within a period of 36 hours.

Clinical Aspects of War Head Injuries

This study covers the period of 15½ months commencing at the beginning of the civil strife on Apr. 13, 1975 and ending on July 31, 1976. During that period 5250 casualties were brought to our emergency rooms. The lowest monthly number, 11 cases, was in August 1975 when there was a lull in the fighting. The highest monthly number, 1134 cases, was in June 1976.

In 1088 patients the diagnosis was not recorded, so that the diagnosis is known in only 4162. Of these, 527 (12.7%) had injuries of the skull. In 271 the skull injury was associated with penetrating brain injury. This group constituted 19.7% of all hospital admissions and just over half of all the head injuries seen in the emergency rooms. Information is available on 219 of these 271 patients. It is this last group on which the following discussion is based.

Classification of Clinical Material

Of the 219 patients 179 were male and 40 female, a ratio of 4.5:1. The reason for the preponderance of males is obvious. All the females were civilians. Among the males there were 67 civilians and 57 fighters; the latter were mostly militiamen, but a few were from the police and army. The fighting status of another 55 male patients was not identified. In other words there were about two civilians for each fighter. This proportion is more apparent than real, because many fighters were transported directly to military and other specialized hospitals. There were 131 shrapnel wounds and 76 bullet injuries; of the former 60 were in civilians and 38 in fighters, a proportion of 1.6:1. Of the bullet injuries 43 were in civilians and 20 in fighters, a proportion of 2.1:1. The unexpectedly high proportion of civilians injured by bullets is due mainly to three factors: (a) snipers were very active and of 12 sniper victims only 1 belonged to the fighter category; (b) stray bullets can be dangerous, as will be shown later, and all 15 persons wounded in this way were civilians; (c) there were five civilians among the six whose injury was due to attempted suicide or was accidentally self-inflicted at short range.

The youngest casualty was not even born; a woman in the eighth month of pregnancy was shot in the pelvis and the bullet lodged in the head of the fetus. The second youngest was 11 days old; he was injured in his crib at home by a nearby rocket blast. The oldest casualty was a 70-year-old man. The majority belonged to the young adult group, between 15 and 30 years, which included most of the fighters. Half of the females seen were under 15 years of age while more than half of the males were between the ages of 15 and 30 years.

Level of Consciousness

We grouped our patients in nine categories depending on the level of consciousness at the time of operation or admission (Table I). Of the 219 patients, 22 could not be classified; 16 were unclassified for lack of pertinent information and the other 6 were simply described as being in coma, without other information being supplied. As will be seen later this classification has an important bearing on prognosis.

Missile Velocity

A further classification was introduced to compare the clinical and radiologic aspects as well as the results of low- and high-velocity projectiles. The kinetic energy of a moving object is directly proportional to its mass and to the square of its velocity. Therefore it is militarily advantageous to increase the velocity of the bullet while keeping its mass reasonably low to allow the warrior to carry a larger supply of ammunition.

The rifles and submachine guns being used were of modern and varied construction delivering high speed bullets with muzzle velocities ranging between 700 and 900 m/s.

The rockets used were of the antipersonnel type with relatively low penetrating power, but at the time of impact they burst, scattering their shrapnel over an area approximately 30 m in radius. Near the site of impact the shrapnel has a high speed which diminishes as the distance from the point of impact increases.

The velocity of a projectile is therefore extremely variable and depends on the type of weapon used and the distance travelled by the projectile. It decelerates from a maximum, which corresponds to the muzzle velocity for bullets or speed at the time and place of explosion for shrapnel, to a minimum reached somewhere on the course of the trajectory. It is therefore difficult to make a clear distinction between high- and low-velocity projectiles. We

Table I—Classification of 197 Patients according to Level of Consciousness at Time of Operation or Admission

Stage	Level of consciousness	No. of cases
1	Fully conscious and well oriented	53
2	Agitated, not fully oriented, but responding sensibly to the spoken word	25
3	Not speaking spontaneously but responding to the spoken word with monosyllables or incoherently	28
4	Not responding to the spoken word but responding to painful stimuli by monosyllables	5
5	Responding to painful stimuli by appropriate movements	13
6	Responding to painful stimuli by inappropriate movements	16
7	Responding to painful stimuli by decerebrate movements	23
8	No response to painful stimuli	17
9	Dead on arrival or shortly afterwards	17

have considered as high-velocity projectiles only bullets, with the exception of the stray ones. We know that shrapnel near the site of explosion has enough energy to pierce the skull from side to side, but its velocity is certainly less than that of bullets fired from modern guns.

Sixty-one of the 76 bullet injuries were classified as the high-velocity type. The remaining 15 bullet injuries were due to stray bullets.

Our experience with stray bullets antedates the present war by many years. It is the custom in our country to shoot in the air at any important occasion, especially marriages and funerals. It is also customary for people to believe that a falling bullet is harmless. This is certainly wrong and if it were not for air friction a bullet shot straight up would have at the time of its impact on the ground a speed equal to the muzzle velocity. In spite of this friction the velocity of a stray bullet is such that it can penetrate the skull of an adult.

Pathology

A low-velocity projectile produces minimal soft tissue reaction that at times is difficult to find under modern hairstyles. Indeed, on two occasions it was totally missed in the emergency room, only to be discovered by the anesthetist during thoracotomy for tamponade. The skull is perforated in a manner similar to a burr hole, with indriven bone fragments lying in proximity to the site of entry (Fig. 1). The shrapnel lies further from the surface. We have noticed that the distribution of these bony and metallic particles depends on their size and weight, the larger and heavier particles usually being driven deeper. Therefore, if a larger particle is seen on the radiograph to be superficial to smaller particles, this often means that it has met some resistance, for example, a blood vessel, ependyma or a reflection of the dura. Low-velocity particles may hit the skull and not penetrate it, yet underneath the site of impact the brain may be contused. An example of this was the case of a 9-year-old girl, affected by a blast from a rocket, in whom three pieces of shrapnel struck the left parietal region. When a craniotomy was performed it was found that two of the three shrapnel fragments had penetrated the skull and brain. The third was lodged in the outer table of the skull beneath which the inner table was intact, yet there was an area of moderate contusion subjacent to it affecting a volume of cerebral tissue of almost 2 mL.

High-velocity missiles produce a totally different picture. The soft tissue suffers severe damage; often there are large gaping wounds especially at the site of exit; in at least 23 cases brain extruded through the exit wound. Brain extrusion was observed in only two cases of injury caused by a low-velocity missile, in both at the site of entry. Because of its greater energy the high-velocity missile often traverses the skull from side to side. In some cases it comes to lie against or within the bone of the side opposite the point of entry. Few bone chips are seen near the entry wound but many are driven deep into the brain. At the exit site the skull seems to have burst. Multiple linear fractures radiate from the sites of entry and exit. They are longer, more numerous and slightly wider at the site of exit (Fig. 2). The dura is lacerated and its edges are shredded, with tears extending several centimetres away from the points of entry and exit. The brain is severely lacerated, contused and devitalized along the track of the projectile and immediately surrounding it. Often hair is seen a few centimetres deep in the severely edematous brain.

A third type of injury that has received little attention in the literature is the tangential injury (18 cases). The higher the velocity of the projectile, the more sizeable and serious is the lesion. One patient had a severely lacerated wound of the scalp with an intact skull beneath it. He was in deep coma upon arrival at the operating room. Craniotomy revealed severe contusion of the brain just beneath the area of impact and an intracerebral hematoma which had burst into the subdural space. In other patients a depressed fracture is visible at the site of impact and, if the energy is greater, bone chips may be driven in as far as the ventricle (Fig. 3). This type of injury can do great harm, especially if it crosses the vertex of the skull, when it produces spastic paraplegia.

Besides the contusion, laceration and destruction of brain tissue, which constitute the common denominator of head injuries in wartime, other specific pathologic findings were observed: there were 23 hematomas, 3 epidural, 12 acute subdural and 8 intracerebral. One patient had an intracerebral hematoma associated with an acute subdural hematoma.

In eight patients the large venous sinuses were involved and in another eight the ventricular system was affected.

In nine cases intracranial air was seen on roentgenograms. Air usually enters through the paranasal air cells and is often accompanied by rhinorrhea. However, it may follow the track of the foreign body in which case it is an indication that the intracranial pressure is not raised.

We received five patients with brain abscess. All were operated upon. Three of these patients had had minor shrapnel injuries deemed by their physicians to be insignificant and no débridement was carried out. The abscesses were diagnosed 20, 25 and 30 days, respectively, after the injury. A fourth patient had a blast injury to her forehead involving both frontal lobes. Superficial débridement was performed by a general surgeon who did not close the dura. Shortly afterwards pus started to ooze from the wound. She was operated on

FIG. 1—Effect of low-velocity missile causing perforation similar to burr hole.

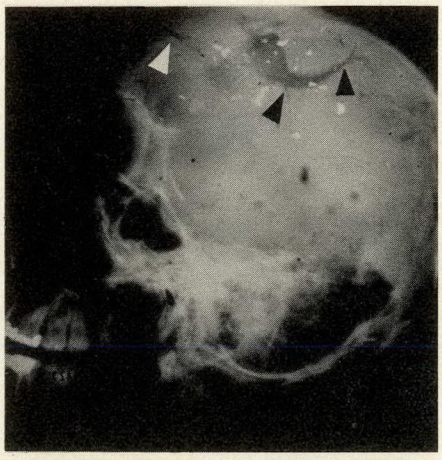


FIG. 2—Effect of high-velocity missile. Entry and exit sites are associated with multiple linear fracture. White arrow indicates fractures at entry site and black arrows indicate fractures at exit site.

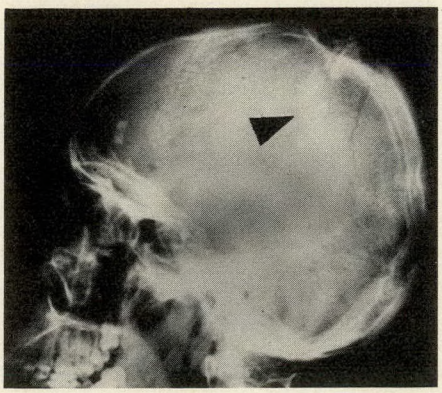


FIG. 3—Effect of tangential impact. Bone chips have been driven deep into brain.

44 days later and a bifrontal abscess reaching the ventricles was excised. The last case was that of a young man who was sitting on his veranda when he felt a severe jolt in his head and blood trickling over his face. He drove his car to the emergency room where he was found to have a bullet lodged in the left temporal lobe. The wound of entry in the right frontal region was thoroughly debrided through a craniotomy. The patient apparently recovered and was discharged, but 1 month from the time of injury he returned complaining of headache and convulsions. An abscess around the bullet was discovered. It was excised and the bullet removed. The final result was satisfactory.

Aneurysms

Traumatic aneurysms are extremely rare. The survey published in 1966 by the central registry of the cooperative study of intracranial aneurysms and subarachnoid hemorrhage,[1] based on 6368 cases, just mentions trauma as an etiologic factor in aneurysm formation. This type of aneurysm does not appear among the complications listed in a reported series of 879 penetrating wounds of the brain incurred during the Korean conflict.[2] Hammon[3] reported 2187 cases of penetrating wounds of the brain treated in Vietnam, in only 2 of which an aneurysm was diagnosed; both patients were evacuated to Walter Reed Hospital, Washington, for surgery. In 1968, Burton, Velasco and Dorman[4] reported one case of traumatic aneurysm. They reviewed the literature and collected an additional 10 cases sufficiently well documented to justify their classification as traumatic aneurysms. Most of these were in civilians and the injury was a fracture of the skull.

This entity was drawn to our attention by two patients very early in the fighting. The first had a blast injury to the face from explosion of a land mine. During his recovery he had inappropriate antidiuretic hormone secretion; arteriography revealed an aneurysm of the external temporal artery. This was excised. By mere coincidence, on the same day a 59-year-old man was injured by a stray bullet while asleep in bed. The bullet had perforated the shutter of his window, penetrated his skull and lodged in the right temporal area. The wound was debrided 8½ hours later and the bullet extracted. He did well for 8 days and was about to be discharged when he suddenly started to suffer from headache and became drowsy. Arteriography revealed an aneurysm on a branch of the middle cerebral artery (Fig. 4). The aneurysm was excised. These cases were eye-openers, especially since berry aneurysms are extremely rare in the Middle East, where for every aneurysm seen 20 brain tumours are diagnosed. These cases made us decide to carry out arteriography routinely on every patient before discharge from hospital. This policy led to the discovery of three additional aneurysms and two carotid cavernous sinus fistulas. After the conclusion of this study we found three more aneurysms and one carotid cavernous sinus fistula within 2 months. In all, we have collected a dozen cases of traumatic aneurysm of the cerebral arteries, which will be the subject of another communication.

Treatment

Most of the acute cases were attended to and definitive surgery was carried out within minutes to several hours after the injury. The average time between injury and operation was 5 hours and 20 minutes. An indication of the efficiency of the medical staff is that 30 patients were operated upon a few minutes to a few hours prior to their formal admission to hospital.

The treatment advocated for such injuries is by now standard: débridement, hemostasis and closure of the dura. Débridement is most important and should be thorough. It should include removal of all devitalized tissue and foreign bodies whenever possible. After evacuation of all clots present and débridement of the macerated and severely contused brain, the line of demarcation becomes obvious. The unhealthy brain tissue is extremely edematous and can be easily suctioned. The brain does not relax unless the clots are removed, the damaged tissue is excised and all the bleeding arrested. Thorough, continuous irrigation is a great help. Unlike Hagan,[5] in his report on his experience from the Vietnam war, we found no untoward effect from retained bone fragments. Although we spared no effort in each case to remove all the bone fragments, these were inadvertently left behind in 14 cases, that is in 8.5% compared with 13.4% in Hagan's series. No further surgery was carried out on our patients (Fig. 5). Although this is against all conventional teaching,[6-10] the case load was such that we had no time to reoperate especially when these patients were doing well. Being the only referral centre to which these patients could return, we relied on a good follow-up. This provided a new control series. Most writers have noted that should an abscess form it will develop within 3 to 6 weeks of injury. This is confirmed by our experience. Our follow-up extends for 3 to 15 months and we have not seen a single brain abscess in cases in which bone fragments were left behind. Furthermore, it is more logical to operate on the occasional brain abscess than to reoperate on all patients with retained bone chips. We believe that a thorough débridement of devitalized brain tissue and removal of accessible foreign bodies, as well as thorough and continuous irrigation of the wound, is much more important than groping in normal brain for retained bone or metallic fragments.

We did not attempt to remove metallic fragments unless they were encountered or found to be moving in roentgenographic studies. Such motion means that the fragment is within a ventricle, a hematoma, or an abscess.

After removal of what appears to be a very large amount of macerated brain, it is surprising how relatively little deficit the patient has.

Perfect hemostasis is the second important step in technique. It certainly is unwise to close a head wound when the brain is still tense. In such cases, it is advisable to follow the track of the missile or to perform a second craniotomy over the area where it is lodged and meet the track of entry.

The third important step in technique is watertight closure of the dura, primarily if possible or by the use of a patch obtained from the epicranium or

FIG. 4—Arteriogram showing traumatic aneurysm on branch of middle cerebral artery.

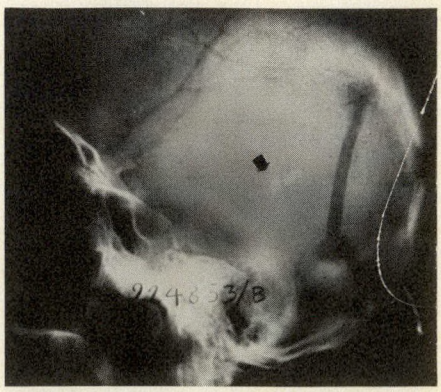


FIG. 5—Two bone fragments inadvertently left in place. No further surgery was needed.

the temporal fascia. In cases of leakage of cerebrospinal fluid, immediate operation is advisable even in the presence of infection. There is no point in waiting until the infection subsides or comes under control. Precious time is thus lost as in the case of one of our colleagues. He heard a knock at the door of his home. As he opened it he was shot by the callers who immediately ran away. The bullet grazed his left temporo-occipital area. He was transported to a hospital in Tripoli where an operation was performed without closing the dura. His condition deteriorated and he was transferred to our hospital, unconscious and responding to painful stimuli by movement of one leg. He had meningitis caused by *Escherichia coli*. We gave him huge doses of antibiotics. His meningitis improved but was not cured. We procrastinated. He had a relapse and died. Another patient was struck tangentially by a bullet on the mastoid area. Six days after surgery cerebrospinal fluid started to leak from the wound and he had a fever of 40°C. He underwent surgery immediately and the rent was sutured. He recovered.

It is frequently advised that large craniectomies should be performed in an attempt to reduce the incidence of infection, to provide space for decompression and to shorten the operation. However, these operations usually leave ugly deformities and necessitate a cranioplasty with its associated risks, temporary disability and expense. Early in the fighting we decided to operate through a craniotomy, at times large enough to include the wounds of entry and exit if these were on the same side. Craniectomy was performed only in cases in which the bone was shattered beyond the possibility of reconstructing the skull and in areas covered with muscle as in the temporal and suboccipital regions. As will be seen later, craniotomies do not carry a higher risk in spite of the abhorrently filthy state of the wounds on admission. The only bone flap we lost was a frontal one where there was already an infected frontal sinus. Since we do not fix the bone flap in place we do not lose the decompressive effect of a craniectomy. Moreover, we find it is more expeditious to carry out a craniotomy, because there is normal dura subjacent to the bone being sawed and because there is much more room to work than is usually afforded by a craniectomy. We have also found that the defect in the scalp can be closed more easily because of the larger flap and the presence of ample tissue to patch the dura.

Results

To assess the results we placed the patients in three categories: (a) those who died upon or very shortly after admission (18 patients); (b) those who were not operated on either because their condition did not necessitate an operation or because they were obviously dying (37 patients); and (c) the majority, who underwent surgery (164 patients).

Of those who were not operated on, 11 died and 26 recovered. Of the 164 patients who were operated on, 45 died. In other words about one third of the patients admitted to hospital died. This high mortality is due to several reasons: (a) none of the patients wore a helmet; (b) patients arrived in the operating theatre very shortly after their injury, sometimes within minutes, so there was no time for natural selection; (c) we operated on 17 patients in deep coma who did not react to any stimulus (12 of these had dilated fixed pupils) and who probably would not have been operated on by other surgeons; (d) the unusual forms of head injury caused by high-velocity missiles; (e) the very difficult conditions under which the hospital was operating, lacking oxygen, blood, respirators and other essential supplies.

A number of factors affected mortality. *Velocity of the projectile* was the most important factor. Of 61 casualties suffering from injury due to high-velocity missiles, 28 (47.5%) died, while of 158 casualties in which the missile was of low-velocity 40 (25.3%) died. The latter included all shrapnel injuries, some of which were detected clinically and were shown by radiologic studies to have been high-velocity shrapnel injuries. If this were taken into consideration the difference in mortality would be even greater than these figures indicate.

When missiles cross the midline *affecting both hemispheres* the mortality increases. In our series there were 45 such cases; of these 23 (51.1%) patients died, which is higher than the overall mortality. The higher mortality is not really due to the missile crossing the mid-line but to its high velocity.

We tried to determine whether *oozing of the brain* through the skull wounds carried a worse prognosis. We had 29 such patients of whom 14 (48.2%) died. This condition also was more common in patients wounded by high-velocity missiles.

Injury to the ventricles did not seem to increase the mortality (three of eight cases, 37.5%).

Also *air within the skull* did not seem to have any effect on the mortality (3 of 10 cases, 30%).

Because we advise *craniotomy rather than craniectomy* it is only fair to compare the mortalities of the two procedures. Of 59 patients subjected to craniotomy, 12 (20.3%) died; of 89 patients who underwent craniectomy, 26 (29.3%) died. The higher incidence for craniectomy is only apparent. The high-velocity bullets, which themselves carry a higher risk, shatter the skull and thus necessitate a craniectomy. The situation is similar in posterior fossa injuries.

As well as the velocity of the projectile, the *state of consciousness at the time of surgery* is most important in determining mortality (Fig. 6), and is directly related to the velocity of the projectile. The deeper the coma the gloomier is the prognosis. Of the 16 patients who could not be classified because of lack of information, 8 died, and of the 6 patients described as being in coma without further specification, 3 died. Of the total of 124 patients classified as being in stages 1 to 5 of consciousness (namely from fully conscious to responsive to painful stimuli by appropriate movements) only 8 patients died (mortality, 6.4%).

Of the total of 56 patients who were in stages of deep coma (ranging from response to painful stimuli by inappropriate movements to no response to painful stimuli), 37 died (mortality, 66%). Of those who recovered there was one child with bilateral dilated fixed pupils and four patients with unilateral dilated pupils. Of those who died, 11 had bilateral dilated fixed pupils and 8 had unilateral dilated fixed pupil prior to operation.

Conclusions

About 10% of all casualties seen during the study period had an injury to the skull and a little more than half of them suffered a penetrating brain injury and were admitted to hospital.

More civilians were victims of bullets than was to be expected, owing to snipers, stray bullets and apparent suicide attempts.

There were three types of injury—

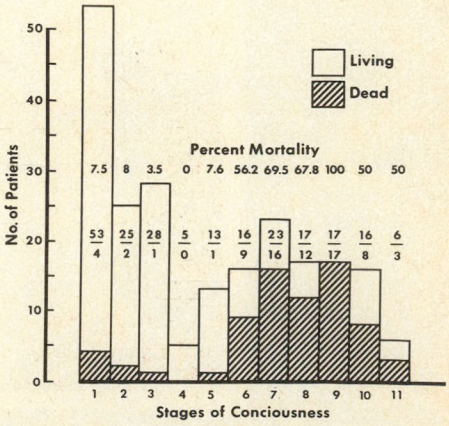
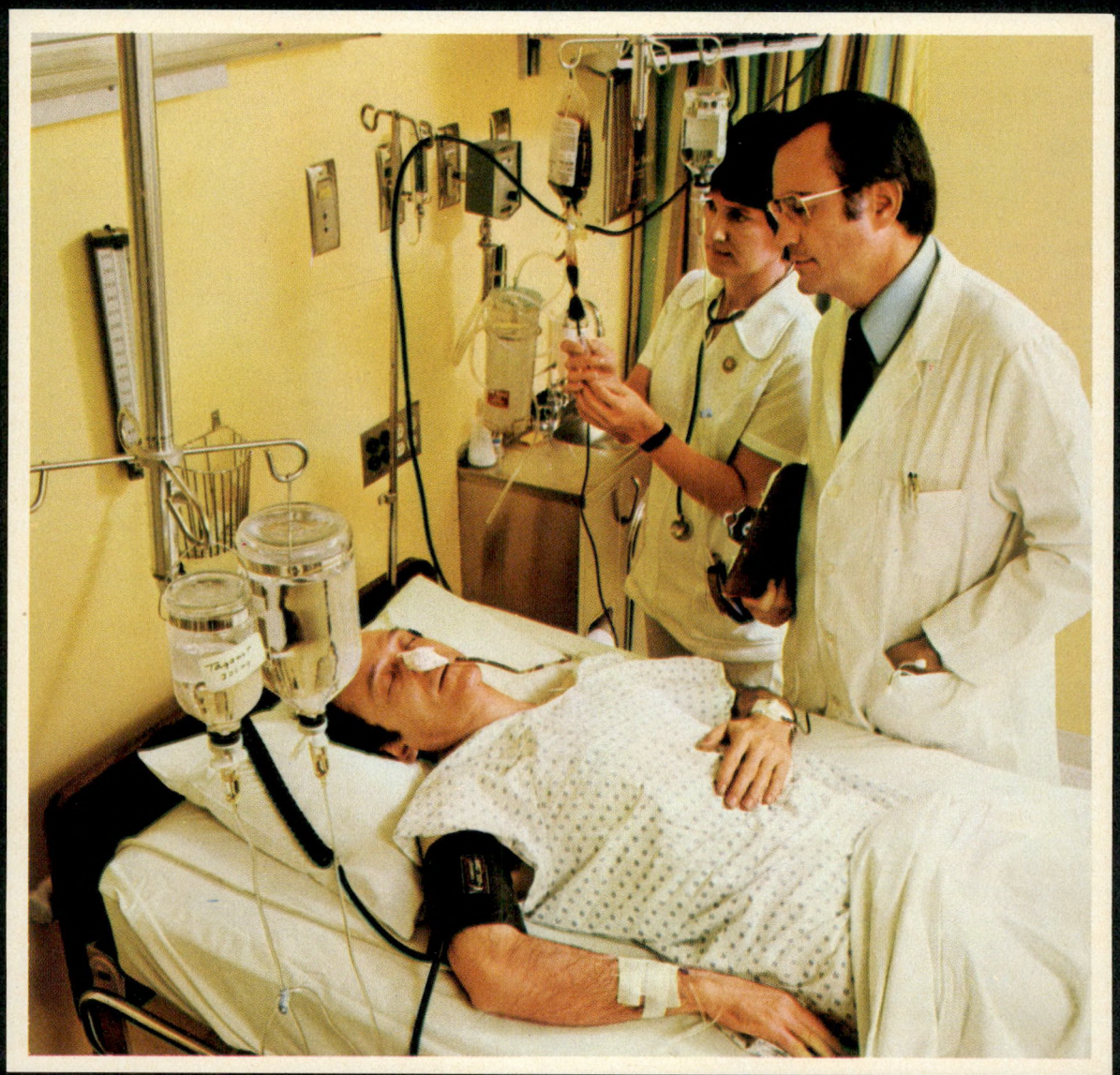


FIG. 6—Histogram showing mortality rate related to different stages of consciousness (see Table I for classification of stages).

To control upper gastrointestinal bleeding due to stress ulcer, hemorrhagic gastritis, stress gastritis, bleeding gastric erosions, duodenal and gastric ulcers...



SK&F
a SmithKline company

New Tagamet®
(cimetidine) injection

The 'Tagamet' effect

The precise mechanism by which 'Tagamet' controls upper g.i. bleeding is not understood, although several theories exist, of which these seem the most likely.

Significantly Inhibits Gastric Acid Secretion,

raising the pH of the stomach to inactivate pepsinogen (thereby decreasing pepsin which is known to digest protein in an acidic environment) and possibly promoting clot formation.

May Decrease Gastric Mucosal Blood Flow

due to inhibition of acid secretion, allowing the body's hemostatic mechanism to control bleeding.

May Prevent Further Damage to the Mucosa

by acid through blockade of histamine H_2 receptors, thereby encouraging healing of the mucosal injury.

65 patients in whom other non-surgical measures had failed, or for whom surgical intervention was considered impossible or unduly hazardous, were evaluated; the results are reported in the adjacent table.[1]

	Complete Success	Partial Success	Complete & Partial Success	Failure
Heavy	65%	15%	80%	20%
Moderate	52%	22%	74%	26%
Subacute/recurrent	45%	25%	70%	30%

1. Data on file, SK&F Medical Department

The H_2 Receptor Antagonist—A major clinical advance for uncontrolled g.i. bleeding

SMITH KLINE &FRENCH CANADA LTD.
Montreal, Quebec H4M 2L6

high velocity, low velocity and tangential.

Craniotomy whenever feasible was found to be superior to the accepted technique of craniectomy. It affords a wider field, better exploration and greater decompression and does not have the disadavantage of requiring a second operation for cranioplasty. The mortality and morbidity are no higher than for craniectomy. We strongly recommend its use.

Retained fragments of bone are not as dangerous as is widely believed. If a thorough débridement of the brain is carried out with perfect hemostasis, one or two deeply placed bone fragments have no deleterious effect, at least for the period of our follow-up ranging from 3 to 15 months. Patients with retained bone fragments should be closely observed for at least 6 weeks.

Traumatic aneurysms are not as rare as the literature indicates. Routine postoperative arteriography is advised since it will disclose aneurysms and lead to definitive surgery.

The most important element in mortality is the high velocity of the projectile at the time of impact and the most important prognostic factor is the state of consciousness of the patient at the time of surgery.

References

1. Report of the cooperative study on intracranial aneurysms. *J Neurosurg* 24: 779, 1966
2. MEIROWSKY AM: Penetrating wounds of the brain, in *Neurological Surgery of Trauma,* COOTES JB JR, MEIROWSKY AM (eds), Washington, Office of the Surgeon General, Dept of the Army, 1965, pp 103-130
3. HAMMON WM: Analysis of 2187 consecutive penetrating wounds of the brain from Vietnam. *J Neurosurg* 34: 127, 1971
4. BURTON C, VELASCO F, DORMAN J: Traumatic aneurysm of a peripheral cerebral artery. Case report. *J Neurosurg* 28: 468, 1968
5. HAGAN RE: Early complications following penetrating wounds of the brain. *J Neurosurg* 34: 132, 1971
6. CAIRNS H, CALVERT CA, DANIEL P, et al: Complications of head wounds, with special reference to infection. *Br J Surg* (war surg suppl no. 1) 198, 1947
7. DREW JH, FAGER CA: Delayed brain abscess in relation to retained intracranial foreign bodies. *J Neurosurg* 11: 386, 1954
8. LEWIN W, GIBSON RM: Missile head wounds in the Korean campaign; a survey of British casualties. *Br J Surg* 43: 628, 1956
9. MEIROWSKY AM: Penetrating craniocerebral trauma. *Clin Neurosurg* 12: 253, 1964
10. HAMMON WM: Retained intracranial bone fragments: analysis of 42 patients. *J Neurosurg* 34: 142, 1971

Annular Pancreas: A New Classification and Clinical Observations

D.W.B. JOHNSTON, MD, FRCS[C], FACS*

Seven cases of annular pancreas are described. In all the diagnosis was confirmed at autopsy or at operation. This study provides a new, original classification for annular pancreas. Two distinct subtypes are described: type 1, extramural and type 2, intramural. In type 1 the presenting symptoms are those of high gastrointestinal obstruction. In type 2 the symptoms are those of duodenal ulceration. For extramural obstructing annuli surgical intervention, if indicated, should be a bypass procedure; for intramural types with duodenal ulcer, subtotal gastrectomy with or without vagotomy is the procedure of choice.

On décrit sept cas de pancréas annulaire. Dans tous les cas, le diagnostic a été confirmé à l'autopsie ou à l'opération. Cette étude a fait naître une classification nouvelle et originale des cas de pancréas annulaire où l'on distingue deux sous-types: le type 1 ou extramural et le type 2 ou intramural. Dans le type 1, les symptômes sont ceux d'une obstruction gastrointestinale haute. Dans le type 2, les symptômes sont ceux de l'ulcère duodénal. Pour un étranglement extramural, l'intervention chirurgicale, lorsqu'elle est indiquée, consiste à pratiquer une anastomose; pour les types intramuraux avec ulcère duodénal, une gastrectomie subtotale, avec ou sans vagotomie, constitue l'intervention de choix.

From the department of surgery, Westminster Hospital and University of Western Ontario, London, Ont.

**Director of surgical studies, Westminster Hospital*

Reprint requests to: Dr. D.W.B. Johnston, Director of surgical studies, Westminster Hospital, London, Ont. N6A 4S2

Annular pancreas is a congenital abnormality which Ravitch and Woods[1] claim was first described by Ecker[2] in 1862.

Under normal conditions the head of the pancreas lies in the arms of the duodenum. When congenital annular pancreas exists the position is reversed; the duodenum lies in, and may be constricted and distorted by, an encircling arm of pancreatic tissue. This anomaly is generally believed to result from failure of the ventral lobe of the pancreas to rotate with its duct.[3] As a result the duct is carried dorsally and to the right, leaving a ring of pancreatic tissue encircling the second part of the duodenum. In addition, aberrant pancreatic tissue accounts for another type of annular formation.[4]

As a result of our experience in seven cases we believe that annular pancreas comprises two distinct subtypes, not previously recognized, that can be classified as: type 1, extramural and type 2, intramural.

In type 1 (Fig. 1) the ring of pancreatic tissue lies on the muscular wall of the duodenum and is covered by a thin layer of peritoneum. A definite plane of cleavage may be established between the annulus and the duodenum. This type always has a main duct which sweeps dorsally and to the right around the duodenum to empty into the common bile duct or into the main pancreatic duct.[5]

In type 2 annulus (Fig. 2) the pancreatic tissue lies buried in the wall of the duodenum; any attempt to dissect out the annulus results in opening the lumen of the duodenum. This type of annulus has no main ductal system but is provided with a network of small canaliculi.

It has been our experience that type 1 is usually associated with a dilated duodenum or megalobulbus and produces symptoms of high intestinal obstruction. Type 2, however, is usually associated with duodenal ulceration and the clinical symptoms are due to the ulcer rather than to the annulus.

The clinical and pathological findings in seven cases of annular pancreas are presented to support this new classification.

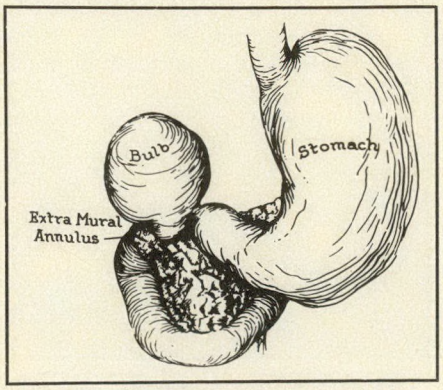


FIG. 1—Extramural annulus.

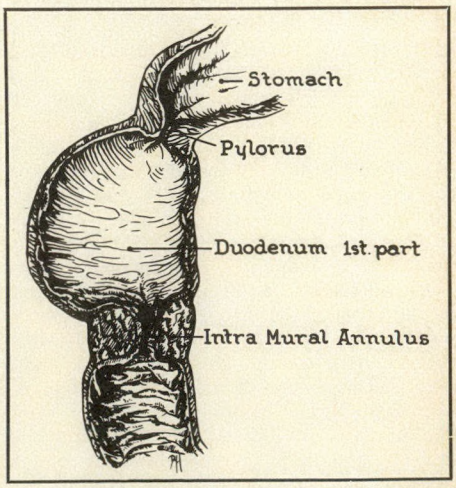


FIG. 2—Intramural annulus.

Case Reports

Case 1.—A 57-year-old man complained

of epigastric distress of 5 years' duration and shortness of breath on exertion. The only abnormality on physical examination was obesity. Radiologic examination revealed an ulcer in the first part of the duodenum; irregularity of the second part of the duodenum did not suggest a specific diagnosis (Fig. 3). Seven months later the patient was again admitted complaining of recurrent attacks of epigastric pain. He was not vomiting and his weight was 108 kg. Roentgenographic findings were identical to those seen previously. On this occasion a diagnosis of annular pancreas was made. Surgery was considered, but we believed this patient should first lose weight and be brought into a more favourable operative condition. Three months later he was admitted again after having lost 18 kg while on a low calorie diet. He was still complaining of epigastric pain and had had one bout of melena and hematemesis. At operation the duodenum was found to be bound down in its second part by a wide band of hardened pancreatic tissue. In view of his history of pain and hematemesis and melena, a subtotal gastrectomy was done. When a finger was inserted into the open end of the duodenum it was found that the whole of the second part of the duodenum was compressed by an extrinsic and an intrinsic mass; the wall of the duodenum felt hard and corrugated. The patient made a good recovery following this operation. He was seen again 12 months later complaining of epigastric distress radiating through to the back and into his chest. He had had a black stool on two occasions. Roentgenography revealed the presence of a stomal ulcer. A transabdominal vagectomy was carried out. The patient died 14 days later of pulmonary embolism. Autopsy confirmed the cause of death and examination of the duodenum showed an annular pancreas of the intramural type.

Case 2.—A 66-year-old man was admitted to hospital complaining of vomiting and weight loss for 7 weeks. The vomiting had become progressively worse during that period; in the preceding week he had retained no food whatsoever. The vomitus was grey and occasionally biletinged. Physical examination was essentially negative except for the classical findings of dehydration. Examination of the abdomen showed peristaltic waves, beginning in the left upper quadrant and passing across to the right of the umbilicus. The left upper quadrant appeared to be fuller than the right upper quadrant and a gastric splash was easily detected. Roentgenography revealed dilatation of the duodenal bulb with gross retention of the barium in the stomach after 2 hours (Fig. 4). A diagnosis of annular pancreas was made. At operation performed 7 days after admission, a large mass was found in the loop of the duodenum. The pylorus was easily located and the grossly distended part of the duodenum was palpated. The cystic duct and the common bile duct were normal. The dilated duodenum was mobilized by dividing its lateral attachments; there was a tongue of pancreas running laterally around the second part of the duodenum. No attempt was made to divide the annulus and an antecolic isoperistaltic duodenojejunostomy was carried out. The patient made a quick recovery following this procedure and remained well for 3 years. He then was admitted to hospital in a cachectic state and died. At autopsy, an anaplastic carcinoma of the pancreas was found. Although no relation has been noted in the literature between annular pancreas and malignancy, Barbosa, Dockerty and Waugh[6] noted a greater frequency of malignant lesions in aberrant than in normal pancreatic tissue. This case is an example of annular pancreas resulting in duodenal obstruction. It is strange that a congenital abnormality should give rise to obstruction so late in life. Perhaps the malignant change with associated tissue proliferation and edema played a part. Probably the large duodenal bulb, when filled with food and fluid, fell over on itself and created a volvulus type of obstruction; the fixed point was the annulus around the second part of the duodenum (Fig. 5).

Case 3.—A 64-year-old man had complained of symptoms typical of duodenal ulcer for many years. Fifteen years earlier a perforated duodenal ulcer had been closed. Since that time he had experienced a sensation of fullness in his upper abdomen and had had frequent bouts of vomiting. The vomiting was worse late in the evening. Physical findings included some fullness in the epigastrium and peristaltic waves passing from left to right across the upper abdomen. Gastrointestinal radiologic findings included a deformity but no dilatation of the duodenal bulb and a small ulcer crater in the first part of the duodenum. In addition, emptying of the stomach was delayed. The radiologic findings led to a diagnosis of scarring deformity of the duodenum with active duodenal ulcer.

At operation the stomach appeared grossly dilated and the duodenum was scarred. Dissection disclosed a tissue mass completely encircling the duodenum and causing constriction to a diameter of about 0.5 cm (Fig. 6). Further dissection in the area identified an annular pancreas with associated duodenal ulcer. A subtotal gastrectomy was performed with an antecolic gastrojejunostomy type of anastomosis. The pathological examination showed a small ulcer in the first part of the duodenum and pancreatic tissue within the duodenal wall (Fig. 7). The postoperative course was smooth. This patient represented a case of intramural annular pancreas associated with duodenal ulceration and obstruction.

Case 4.—A baby boy, weighing 2184 g, was admitted to hospital at the age of 4.5 days with a history of nonbilious vomiting since birth. A flat film showed gas in the stomach and first part of the duodenum (double bubble)[7] but no gas in the rest of the gastrointestinal tract. The baby's general condition was good except

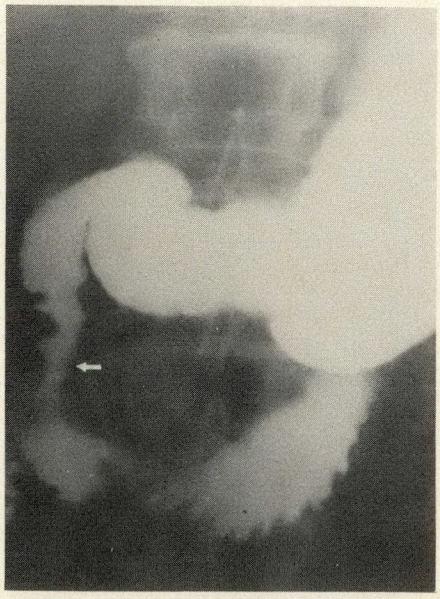


FIG. 3—Case 1. Narrowing and irregularity of second part of duodenum.

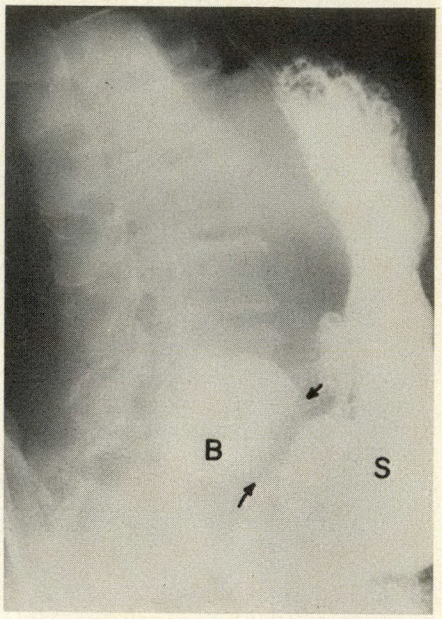


FIG. 4—Case 2. Megalobulbus (B) of duodenum and retention of barium. Arrows indicate pylorus, S = stomach.

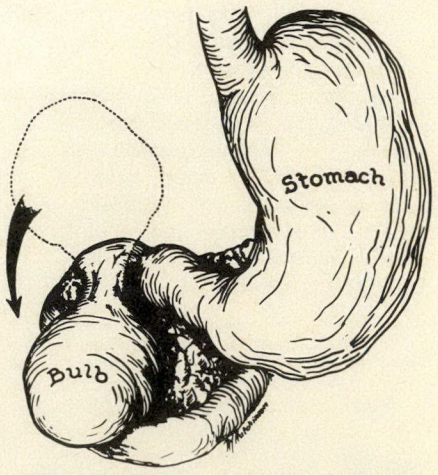


FIG. 5—Case 2. Probable explanation for delayed obstruction. Megalobulbus rotates creating volvulus type of obstruction.

for moderate dehydration. A diagnosis of duodenal obstruction above the ampulla was made. At laparotomy a malrotation was found together with annular pancreas around the first part of the duodenum. An anterior gastroenterostomy was done as there was not room enough for a duodenojejunostomy. The postoperative course was smooth and the baby was discharged from hospital 20 days after admission weighing 2700 g. A postoperative film showed gas in the small bowel indicating that the obstruction was relieved. On follow-up almost 3 months after operation, the baby appeared in good health. He was taking food well and weighed 3600 g.

Case 5.—This young man was brought to hospital with severe burns suffered in an industrial accident. He died a few hours after admission. Autopsy revealed an annular pancreas of the extramural type with marked dilatation of the duodenal bulb (Fig. 8). Unfortunately the previous history of this man is unknown so we cannot tell whether he suffered from bouts of duodenal obstruction.

Case 6.—Autopsy of a 66-year-old woman whose death was unrelated to pancreatic disease (myocardial infarction) revealed an annular pancreas of the intramural type with no other evidence of disease (Fig. 9). The patient had a history of dyspepsia for which she had undergone cholecystectomy several years before.

Case 7.—A 68-year-old man was admitted with a diagnosis of duodenal ulcer. Radiologic examination of the gastrointestinal tract showed a penetrating ulcer of the duodenum and a filling defect distal to it suggestive of annular pancreas (Fig. 10). His symptoms subsided and he was discharged. He returned to hospital 1 month later with several rib fractures sustained after falling from a tree. Bilateral pneumonia developed and the patient died. Autopsy confirmed the diagnosis of annular pancreas.

Discussion

As a result of this study of seven patients with annular pancreas a new classification for the condition is suggested. There appear to be two distinct subtypes: extramural annular pancreas and intramural annular pancreas. In the former, pancreatic tissue along with the pancreatic duct, lying on the serosal surface, constricts the duodenum. The symptoms are those of high gastrointestinal obstruction as in our cases 2, 4 and 5. The obstruction is probably due to volvulus of the megalobulbus or, perhaps, to low-grade pancreatitis secondary to abnormal pancreatic duct anatomy.[8] Surgical treatment is most successful if a simple bypass procedure is carried out.

In the second type, aberrant pancreatic tissue lies intramurally and the complications are those of duodenal ulceration as in cases 1, 3, 6 and 7. This ulceration is most likely due to antral distension[9,10] with release of the hormone gastrin. This makes the etiology consistent with that of type 3 stimulating phase of gastric secretion.[11] Surgical treatment in type 2 annuli is subtotal gastrectomy, with or without vagotomy.

I thank Dr. Donald Marshall for permission to describe his patient, Case 4, and would also like to acknowledge the financial assistance provided by Mr. G. Dingman of St. Thomas, Ontario.

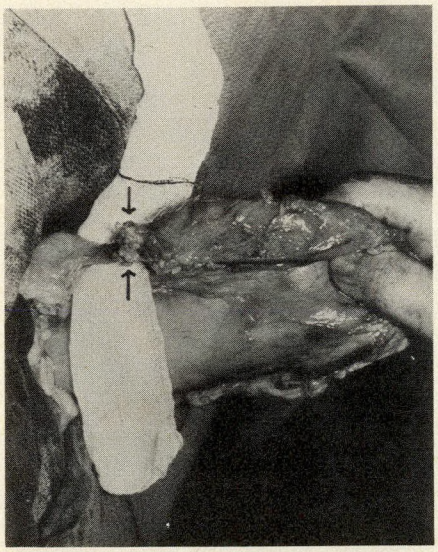


FIG. 6—Case 3. Annulus (arrows) encircling duodenum and causing constriction.

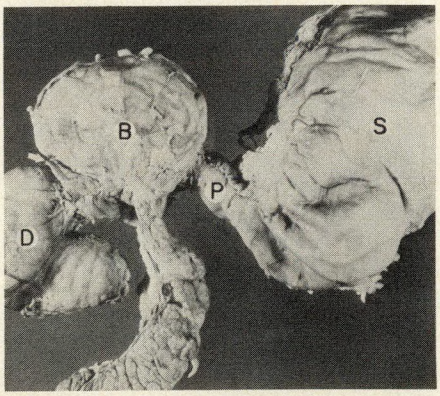


FIG. 8—Case 5. Autopsy specimen shows annulus (arrow) of extramural type with obstruction. D = second part of duodenum, B = megalobulbus, P = pyloric canal, S = stomach.

FIG. 7—Case 3. Intramural pancreatic tissue (hematoxylin and eosin, reduced by 49% from original magnification ×40).

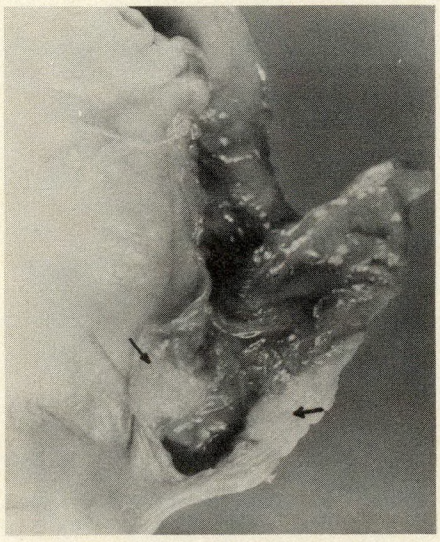


FIG. 9—Case 6. Duodenum opened to show annulus, intramural type.

References

1. RAVITCH MM, WOODS AC JR: Annular pancreas. *Ann Surg* 132: 1116, 1950
2. ECKER A: Malformation of pancreas and heart. *Z Rat Med* 119: 391, 1910
3. LECEO TM: Zur Morphologie des Pancreas annulares. *Sitzungsberichte*

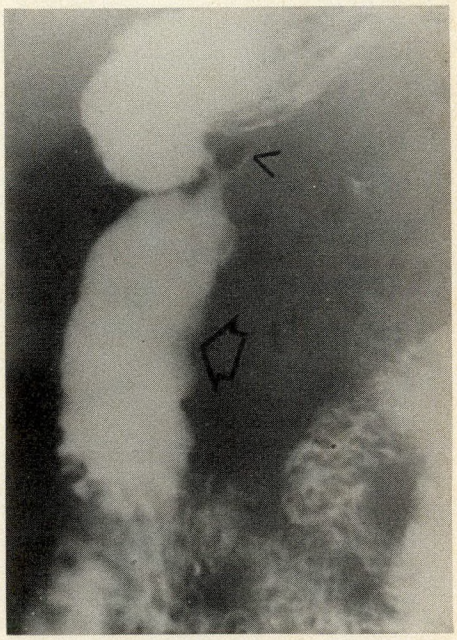


FIG. 10—Case 7. Filling defect distal to penetrating ulcer of duodenum, suggesting presence of annular pancreas.

der Akademie der Wissenschaften Wien 119: 391, 1910
4. WORTHIN AS: Two cases of accessory pancreas. *J Phys Surg* 26: 337, 1904
5. ANDERSON JR, WAPSHAW H: Annular pancreas. *Br J Surg* 39: 43, 1951
6. BARBOSA JJ DE C, DOCKERTY MB, WAUGH JM: Pancreatic heteropia; review of literature and report of 41 authenticated surgical cases, of which 25 were clinically significant. *Surg Gynecol Obstet* 82: 527, 1946
7. HOPE JW, GIBBONS JF: Duodenal obstruction due to annular pancreas with differential diagnosis of other congenital lesions producing duodenal obstruction. *Radiology* 63: 473, 1954
8. DREY NW: Symptomatic annular pancreas in the adult. *Ann Intern Med* 46: 750, 1957
9. WOODWARD ER, ROBERTSON C, FRIED W, et al: Further studies on the isolated gastric antrum. *Gastroenterology* 32: 868, 1957
10. WOODWARD ER, NYHUS LM: Vagal and antral mechanisms in gastric secretion. *Am J Med* 29: 732, 1960
11. NYHUS LM, CHAPMAN ND, DEVITO RV, et al: The control of gastrin release. An experimental study illustrating a new concept. *Gastroenterology* 39: 582, 1960

Nonoperative Removal of Retained Common-Bile-Duct Stones

C.S. HO, MB, BS, FRCP[C]

The discovery of retained common-bile-duct stones after operations on the gallbladder continues to be a frustrating experience for the general surgeon. Until recently this problem was solved in most patients by surgical re-exploration of the common bile duct. However, several alternatives to surgery are gradually gaining acceptance because of their lower morbidity and mortality. These methods are discussed with special emphasis on the use of a catheter with a steering mechanism and the Dormia basket (Burhenne's technique). This is the best alternative to surgery as it has no reported mortality, few complications and causes the least discomfort to the patient. It is highly successful and requires no hospitalization.

La découverte de calculs retenus dans le canal biliaire après une opération de la vésicule continue d'être une source de frustration pour le chirurgien général. Jusqu'à récemment, ce problème était résolu chez la plupart des patients par une réintervention chirurgicale du canal biliaire. Toutefois plusieurs alternatives à la chirurgie gagnent graduellement en popularité grâce à leur morbidité et leur mortalité plus faibles. Ces méthodes sont discutées, une attention spéciale étant donnée à l'utilisation du cathéter à mécanisme de direction et à pannier Dormia (technique de Burhenne). C'est là la meilleure alternative à la chirurgie puisqu'aucune mortalité n'a été signalée en rapport avec cette intervention, qu'elle entraîne peu de complications et qu'elle cause le moins de malaises au patient. Elle a un fort taux de réussite et ne requiert pas l'hospitalisation.

From the department of radiology, Toronto General Hospital, Toronto, Ont.

Presented at the inaugural meeting of the Canadian Association of General Surgeons, Toronto, May 11 and 12, 1977

Reprint requests to: Dr. C.S. Ho, Department of radiology, Toronto General Hospital, Toronto, Ont. M5G 1L7

In the United States, about 400 000 cholecystectomies are performed each year.[1] About 15% or 60 000 of the patients have stones in the common bile duct (CBD) that require operation; 4000 will have residual stones in their biliary tree following surgery.[1] Taking the Canadian population to be one tenth of that of the US, one can assume that each year at least 400 Canadians, if not more, will face this distressing situation.

Five methods are available for the management of retained CBD stones: (a) leaving the stones in situ and withdrawing the T tube; (b) surgical re-exploration; (c) dissolution of stones using ether or chloroform, heparin, or bile acids or bile salt solutions; (d) endoscopic papillotomy; and (e) nonoperative extraction with Dormia basket (Burhenne's technique).[2]

Leaving Stones in situ

In patients who are elderly and sick, the risk of complications from retained stones is lower than that of surgical re-exploration. Leaving the stones behind and withdrawing the T tube used to be an accepted mode of management. From a review of the literature, Way[1] concluded that the majority of retained CBD stones are asymptomatic. However, when the patient eventually has to be operated on because of complications, he is a less satisfactory candidate for operation than previously. Antibiotics usually bring the acute process under control. This method of management is no longer acceptable as the first alternative and should be considered only when other methods are not available.

Surgical Re-exploration

Re-exploration of the CBD is not only technically more difficult but also carries a higher morbidity and mortality than simple cholecystectomy. Furthermore, the success rate for removing retained stones at re-exploration is 73% to 83%,[3,4] so that a third or even a fourth operation may be required. Surgery should be reserved as the last resort when other methods have failed.

Dissolution of Retained Stones

This would be an ideal method of treatment if suitable agents were available. In the 1930s ether[5] and, later, chloroform[6] were used for stone dissolution. Both these solvents are effective in dissolving cholesterol stones. However, ether can produce severe right upper quadrant pain when introduced into the CBD, and chloroform is potentially toxic to the liver parenchyma. Their use in this situation has been abandoned.

Infusion of the CBD with heparin was described by Gardner, Ostrowitz and Masur[7] as an effective method for stone dissolution. Heparin, by supplying negative charges that adsorb to the micelles, is believed to produce an increase in the dispersion of micelles in the bile. Others attempting to duplicate this method have not met with equal success.[1] The use of heparin for dissolution of gallstones must be evaluated further.

Cholesterol stones constitute 95% of gallstones. The formation of these stones is believed to be related to the excess of cholesterol in relation to bile salts and lecithin in the bile. The finding that cholesterol stones can be dissolved in test tubes containing bile salt solution has been applied to dissolution of gallstones in the gallbladder[8] and to retained stones in the CBD.[9]

Currently, dissolution of retained CBD stones by bile salts is achieved either by oral administration of bile acids or by direct infusion of bile salt solutions into the CBD through the T tube. Chenodeoxycholic acid (approximately 1 g/d, orally) is prescribed for 8 to 13 weeks. The oral method may take a long time and the success rate is not impressive. Nevertheless it does not require the presence of a T tube and may have a place after all other conservative methods have failed.

Direct infusion of bile salt solutions into the CBD requires hospitalization for 10 to 14 days because the rate and pressure of infusion have to be carefully regulated. Infusion at excessive pressure can induce pain, cholangitis, or leakage. This method has a success rate of about 67%.[9] The complications of dissolution by bile salt solutions are insignificant. The use of the drug is still restricted and available to only a few investigators.

Endoscopic Papillotomy

Modern fiberoptic endoscopy has introduced a new dimension to the management of CBD stones. By means of a duodenoscope and a papillotome, endoscopic papillotomy or sphincterotomy can be performed without general anesthesia. The construction of a papillotome is simple; it consists of a polyethylene cannula and a small wire that passes through it and is attached to its distal end. High-frequency currents can be passed through the wire for cutting. In endoscopic papillotomy the papillotome is passed into the ampulla of Vater through the duodenoscope. When correctly positioned as checked by fluoroscopy, the wire of the papillotome is pulled to produce bowing of the distal cannula. High-frequency current is then passed, resulting in cutting of the ampulla. After a successful papillotomy a Dormia basket can be threaded through the duodenoscope into the CBD and the stones retrieved. More commonly, the stones are allowed to pass spontaneously into the duodenum after the papillotomy. Endoscopic retrograde cholangiopancreatography (ERCP) is performed later to check for the presence or absence of stones. First introduced in the early 1970s by the Japanese[10] and Germans,[11] the method has gradually gained popularity in Europe. Table I shows the complications of the procedure as performed by various authors[12-14] in 344 patients in different European centres. The mortality rate of 1.5% and morbidity of 11% compare favourably with the figures for surgical re-exploration or surgical sphincteroplasty. However, these results are less impressive than those for extraction with the Dormia basket (Burhenne's technique)—no deaths and 5% morbidity.[15] The procedure requires an expert endoscopist with extensive experience in performing ERCP. In expert hands a success rate of 85% can be expected. It should be the treatment of choice for retained CBD stones in high-risk patients whose T tube has slipped out and in those with CBD stones who are too ill to undergo surgery. The routine use of endoscopic papillotomy for treatment of CBD stones is not advocated.

Table I—Complications of Endoscopic Papillotomy in 344 Patients*

Complication	No. of patients
Hemorrhage	11
Pancreatitis	4
Perforation	15
Cholangitis	5
Trapped basket	2
Total morbidity	37 (11%)

*5 patients (1.5%) died.

Nonoperative Removal of CBD Stones

The first successful retrieval of CBD stones by a specially designed forceps was described by Mondet in 1962.[16] Mazzariello[17] popularized the concept of nonoperative retrieval of stones, using both forceps and the Dormia basket. Burhenne[2] and Bean and Mahorner[18] have simplified the procedure. As it is performed under fluoroscopic control, more and more radiologists are now familiar with it so that it is a readily available therapeutic procedure in many centres. The details of the method have been well described by Burhenne who incorporated in the catheter a steering device (Fig. 1) to facilitate the Dormia basket reaching the calculus in the CBD.

The procedure is not performed until 4 to 5 weeks after the initial surgery in order to allow a firm, fibrous tract to form. Preliminary T-tube cholangiography is performed to check the number and location of the stones if still present. The T tube is then withdrawn. Under fluoroscopic control the steerable catheter is introduced into the

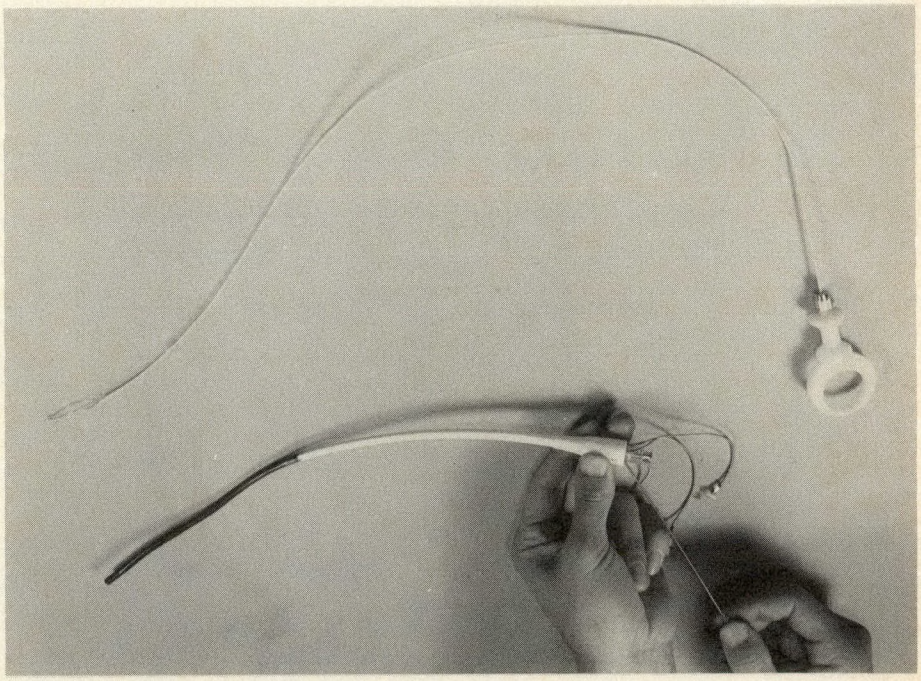


FIG. 1—Steerable catheter with four wires passing through its wall to its distal end. By pulling open end of wire, tip of catheter can be manipulated to desired position. Dormia basket can be threaded through catheter.

CBD along the T-tube tract. When the tip of the catheter reaches the calculus, the Dormia basket is threaded into the catheter to reach the stone. By opening and closing the basket under fluoroscopic control, the stone can be trapped; the basket, stone and catheter are then removed together. The entire procedure, depending on the number of stones present and the skill of the operator, usually takes from 15 minutes to 2 hours. When there are numerous stones, more than one session may be required. In order to facilitate retrieval and reduce morbidity, a T tube of adequate size should be used, preferably no. 14 French or larger. The T-tube tract should be straight, as a tortuous tract makes retrieval difficult. Hard and large stones (diameter, $\geqslant$ 2 cm) are difficult to remove.

Table II lists the complications in 643 patients who underwent nonoperative retrieval of CBD stones in different centres in the US and Canada[18] and includes my own cases. No deaths, perforations of the CBD or subphrenic abscesses have been reported. A morbidity of 5% is recorded and 0.5% of patients have required reoperation.

The nonoperative extraction can be performed on an outpatient basis. A success rate of 95% in expert hands can be expected. It can also be performed on patients considered to be of high surgical risk. If the procedure is unsuccessful, a red rubber catheter is reinserted into the CBD to maintain drainage and nothing is really lost. It is certainly a cost-effective procedure and it also produces less discomfort for the patient than other methods. It is currently the choice for retained CBD stones in patients who still have the treatment T tube in place.

The following case report illustrates that despite a meticulous search for a CBD stone known to be present, it may occasionally be missed at operation. It also shows that reoperation does not necessarily guarantee the complete removal of a residual stone.

Case Report

A 47-year-old housewife had had a cholecystectomy 10 years earlier. Forty-eight hours before admission to another hospital, she experienced severe colicky pain in the right upper quadrant, associated with vomiting. Twenty-four hours later she became febrile, jaundiced and mentally confused. Her blood pressure was 60/40 mm Hg, pulse 160/min and her temperature 40°C. The diagnosis was septic shock due to ascending cholangitis. She was resuscitated by means of intravenous fluid and antibiotics and admitted to the Toronto General Hospital for further management.

On admission her blood pressure was 120/60 mm Hg, pulse 130/min. Abdominal examination revealed tenderness in the right upper quadrant but no mass was palpable. The hemoglobin value was 12.1 g/dL, the leukocyte count 17 $\times$ 10^9/L, the platelet count was 94 $\times$ 10^9/L and the prothrombin time 14 seconds (normal, 11 seconds). Her urine was strongly positive for bile and urobilinogen. Enterococci were cultured from the blood.

At emergency operation the CBD appeared dilated and aspiration showed murky looking bile. Exploration of the duct permitted removal of several stones. A choledochoscope was also used to seek for other stones and an operative cholangiogram was obtained (Fig. 2). No residual stones could be demonstrated.

A T-tube cholangiogram obtained 1 week after the exploration showed a stone (diameter, 1 cm) at the junction of the left and right hepatic ducts (Fig. 3). The patient was discharged and instructed to return in 5 weeks for nonsurgical extraction. Shortly before the end of the 5th week the T tube slipped out and she again experienced right upper quadrant pain. Upon readmission an ERCP visualized obstruction of the CBD by a large stone at its lower end (Fig. 4).

At a second operation, despite a thorough search, the stone could not be located. A sphincteroplasty was performed and a large T tube left in place. Again operative cholangiography showed no residual stone (Fig. 5). The biliary tree, however, was uniformly distended. Postoperative T-tube cholangiography revealed a large stone in the left hepatic duct (Fig. 6). This was subsequently removed by the nonoperative technique using the Dormia basket.

Table II—Morbidity of Nonoperative Removal of Retained Common-Bile-Duct Stones in 643 Patients

Complication	No. of patients
Perforation of sinus tract	8
Subhepatic bile collection	2
Fever	12
Sepsis	2
Pancreatitis	2
Vasovagal reactions	2
Trapped basket	2
Total morbidity	30 (5%)

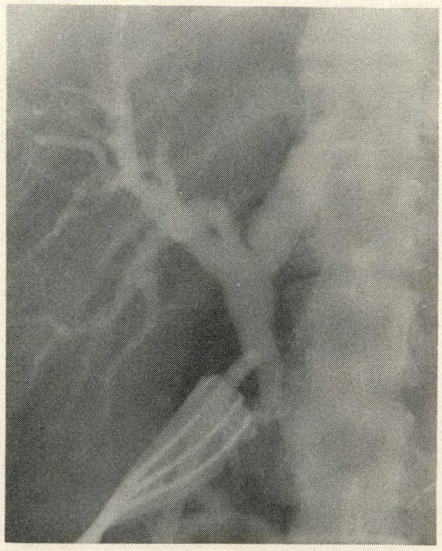


FIG. 2—Operative cholangiogram showing no evidence of residual stone in biliary tree.

Summary

The best method of management of retained stones in the biliary tree is to ensure that they do not occur. The use of cholangiography and choledochoscopy at operation will reduce the incidence to a minimum. Even these measures may fail, and in these circumstances it is now a great relief both

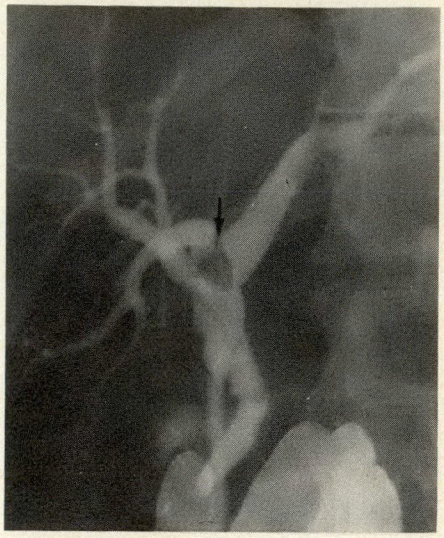


FIG. 3—T-tube cholangiogram demonstrating stone at junction of left and right hepatic ducts (arrow).

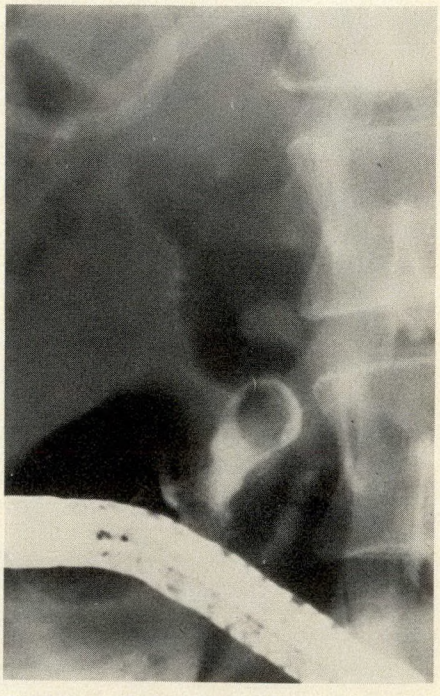


FIG. 4—Endoscopic retrograde cholangiopancreatogram showing air in biliary tree and large stone located at distal end of dilated common bile duct (CBD).

to the surgeon and to the patient that a second operation need not be necessary. In fact, if an adequate sized T tube is left, the chances of successful removal of the stones without operation are extremely high and, conversely, the likelihood of having to consider an alternative method is quite low. Surgery should be the last resort. Undoubtedly a radical change in the approach to the management of retained stones has taken place during the last decade.

I am most grateful to Miss Sue Harris, Mrs. Eileen Lunny and Miss Ingrid Breitenauer for secretarial assistance.

References

1. WAY LW: Retained common duct stones. *Surg Clin North Am* 53: 1139, 1973
2. BURHENNE HJ: Nonoperative retained biliary tract stone extraction: a new roentgenologic technique. *Am J Roentgenol* 117: 388, 1973
3. HUGHES ES: Recurrent and residual stones in the common bile-duct. *Br J Surg* 43: 198, 1955
4. SMITH SW, ENGEL C, AVERBROOK B, et al: Problems of retained and recurrent common bile duct stones. *JAMA* 164: 231, 1957
5. PRIBAM BA: The method for dissolution of common duct stones remaining after operation. *Surgery* 22: 806, 1947
6. BEST RR, RASMUSSEN JA, WILSON CE: An evaluation of solutions for fragmentation and dissolution of gallstones and their effect on liver and ductal tissue. *Ann Surg* 138: 570, 1953
7. GARDNER B, OSTROWITZ A, MASUR R: Reappraisal of the possible role of heparin in solution of gallstones: a clinical extension of laboratory studies in removal of retained common duct stones. *Surgery* 69: 854, 1971
8. DANZINGER RG, HOFMANN AF, SCHOENFIELD LJ, et al: Dissolution of cholesterol gallstones by chenodeoxycholic acid. *N Engl J Med* 286: 1, 1972
9. WAY LW, ADMIRAND WH, DUNPHY JE: Management of choledocholithiasis. *Ann Surg* 176: 347, 1972
10. KAWAI K, NAKAJIMA N, KIMOTO K, et al: Endoscopic sphincterotomy of the ampulla of Vater. *Endoscopy* 7: 30, 1975
11. CLASSEN M, DEMLING L: Endoskopische Sphinkterotomie der Papilla Vateri und Steinextraktion aus dem Ductus choledochus. *Dtsch Med Wochenschr* 99: 496, 1974
12. SAFRANY L: Duodenoscopic sphincterotomy and gallstone removal. *Gastroenterology* 72: 338, 1977
13. RÖSCH W: Workshop: operative endoscopy. *Endoscopy* 7: 157, 1975
14. COTTON PB, CHAPMAN M, WHITESIDE CG, et al: Duodenoscopic papillotomy and gallstone removal. *Br J Surg* 63: 709, 1976
15. BURHENNE HJ: Complications of nonoperative extraction of retained common duct stones. *Am J Surg* 131: 260, 1976
16. MONDET A: Técnica de la extracción incruenta de los cálculos en la lithiasis residual del colédoco. *Bol Soc Cir B Air* 46: 278, 1962
17. MAZZARIELLO R: Removal of residual biliary tract calculi without reoperation. *Surgery* 67: 566, 1970
18. BEAN WJ, MAHORNER HR: Removal of residual biliary stones through the T-tube tract. *South Med J* 65: 377, 1972

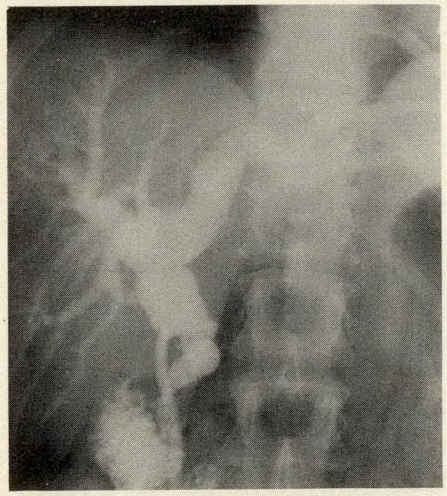


FIG. 5—Second operative cholangiogram showing general distension of CBD and intrahepatic radicals. No stones are seen.

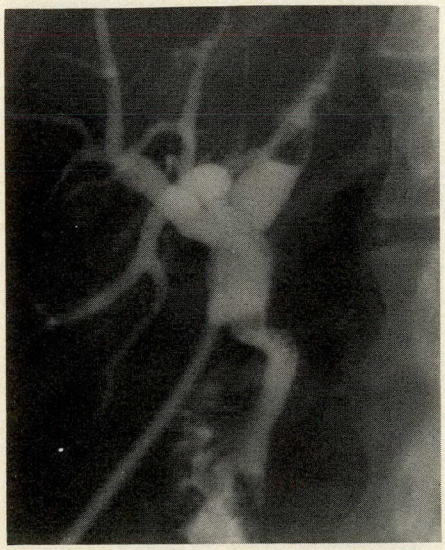


FIG. 6—Postoperative cholangiogram showing same stone as in Fig. 4 located in left hepatic duct.

BOOKS RECEIVED

continued from page 229

Dictionary of Medical Ethics. Edited by A.S. Duncan, G.R. Dunstan and R.B. Welbourn. 336 pp. Darton, Longman & Todd Ltd., London, 1977. $12.75, paperbound. ISBN 0-232-51302-3.

Disorders of the Patello-Femoral Joint. R. Paul Ficat and David S. Hungerford. 249 pp. Illust. The Williams & Wilkins Company, Baltimore; Burns & MacEachern Limited, Don Mills, 1977. $30.95. ISBN 0-683-03200-3.

Dx and Rx: A Physician's Guide to Medical Writing. John H. Dirckx. 238 pp. G.K. Hall & Co., Boston, 1977. $12.95. ISBN 0-8161-2100-1.

Farquharson's Textbook of Operative Surgery. 6th ed. Edited by R.F. Rintoul. 963 pp. Illust. Churchill Livingstone, Edinburgh; Longman Canada Limited, Don Mills, 1978. $64. ISBN 0-443-01363-2.

continued on page 256

Slimpses of Surgical History: U for Universities

DAVID A.E. SHEPHARD

Universities have so shaped the education and training of surgeons in an accepted tradition that we forget that these "thinking shops" are of relatively recent origin. They have served us for barely 800 years. Galen died in 200 AD; after him came almost a millenium of darkness and in the West a new dawn did not break until the school of Salerno rekindled interest in Greek and Latin texts. Then, within two centuries there arose universities in whose debt surgeons will always remain.

The first university, at Salerno, was in fact a medical university. A great tradition thus began—the tradition that grew through the Renaissance of the 12th century and the second Renaissance of the 14th and 15th centuries, and then the "invisible college" of the 17th century, to the growth of knowledge closer to our day. Salerno was followed by Naples, Montpellier, Bologna, Paris and Padua, and then, in the 13th century by Oxford and Cambridge. All these universities were established in bookless days—at the end of the 14th century the Paris medical school library contained but a dozen manuscripts—yet they forged new ways of learning.

The growth of universities changed the ways scholars could learn. No longer was learning restricted to the Church; learning was made available to all. Moreover, "the ancient and universal company of scholars" broke down the barriers of custom and authority that had previously closed men's minds. One such scholar was a surgeon —Guy of Chauliac, "the restorer of surgery". Surgeons thus have every reason to be proud of the contributions their forbears made to the university tradition.

But what is this tradition? It is not physical—stone and glass crumble and splinter and cap and gown fray and fall apart. What have lasted are the word university, *the curricula leading to degrees and the faculty concept. The tradition is "the training of scholars and the maintenance of the tradition of learning and investigation". This tradition has lasted to our day; it is a tradition today's surgeons can share with scholars of former times, surgical and lay alike. Surely surgeons will continue to preserve such a fine tradition.*

Survival after Late Disc Dislodgement of a Mitral Wada-Cutter Prosthesis

ELLIOT T. GELFAND, MD, FRCS[C], JOHN C. CALLAGHAN, MD, FRCS[C], FACS, FACC AND RUSSELL F. TAYLOR, MD, FRCP[C], FACP

A 33-year-old woman, 6 years after placement of a Wada-Cutter prosthesis, suffered from free mitral regurgitation secondary to the dislodgement of the disc occluder into the left atrium. She was operated on approximately 14 hours after the onset of symptoms and survived; this patient is the third reported survivor following dislodgement of a Wada disc.

Six ans après la pose d'une prothèse Wada-Cutter, une femme de 33 ans a présenté une régurgitation mitrale continue à la suite du détachement du disque refermant l'oreillette gauche. Elle a été opérée environ 14 heures après l'apparition des symptômes et a survécu; cette patiente est la troisième dont on a signalé la survie après le détachement d'un disque de prothèse Wada-Cutter.

One of the most disastrous complications to beset the patient with a prosthetic heart valve is complete dislodgement of the disc occluder. In the literature to this time only two survivors of Wada disc dislodgement have been reported.[1,2] We report the case of a third patient who survived disc dislodgement.

Case Report

A 27-year-old woman with severe aortic and mitral regurgitation underwent replacement of her aortic valve with a Cutter-Smeloff prosthesis and mitral valve with a Wada-Cutter prosthesis. Her postoperative course was uncomplicated and in the following 6 years she had no related problems. Suddenly, shortly after arising in the morning, the patient noted severe lightheadedness and shortness of breath. She was admitted to a local hospital 960 km from the University of Alberta Hospital, where she was noted to have frank pulmonary edema. Throughout that day she was treated with diuretics; in addition, an endotracheal tube was inserted and positive pressure ventilation begun. The patient was transported to the University of Alberta Hospital by air ambulance 12 hours after she first experienced difficulty.

At the time of admission the patient's heart rate was 120 beats/min; she was in sinus rhythm with runs of ventricular tachycardia. Her blood pressure was 60/40 mm Hg and she was anuric. Her jugular venous pressure was considerably elevated and even with volume ventilation through an endotracheal tube her condition did not improve and the pulmonary edema persisted. Aortic prosthetic sounds seemed normal, but no mitral prosthetic sound was audible. An echocardiogram failed to disclose any movement of the mitral valve prosthesis; severe malfunction of the Wada valve was diagnosed.

Two hours after admission the patient's previous sternotomy wound was reopened and perfusion for cardiopulmonary bypass was carried out through the right femoral artery. Hypothermic myocardial protection was provided by the infusion of 600 mL of buffered lactated Ringer's solution at 4°C into the aortic root after placement of an aortic cross-clamp. When the left atriotomy was made the Wada disc occluder was found lying free in the left atrium. The valve ring was well seated in the mitral annulus and no evidence of thrombus or abundant pannus was noted. The occluder was removed, the valve ring excised and a Lillehei-Kaster supra-annular mitral prosthesis was sutured into place with interrupted horizontal mattress sutures on Teflon felt pledgets. The patient made an uneventful postoperative recovery and at present is well.

Discussion

The Wada-Cutter hingeless mitral prosthesis was proposed to provide better central flow and less turbulence than other mitral prostheses available at that time. Since the first report on the use of this valve by Wada and colleagues[3] in 1969, however, numerous complications of the prosthesis have been reported,[4-6] and this device is no longer used clinically in the mitral position. In a discussion of a paper by Roe and his group[2] in 1975 Wada stated that his institution had discontinued use of this prosthesis in the mitral position in 1974.

Despite the fact that this prosthesis is no longer used, large numbers of patients in whom it was implanted are still being followed up. Because of the complications associated with this valve, and in particular the potentially disastrous disc dislodgement, careful re-evaluation of these patients is mandatory. Perhaps in this group of patients prophylactic removal of the Wada prosthesis and replacement with a more durable device would be prudent.

The development of severe overwhelming regurgitation in an implanted heart valve is a medical and surgical emergency. The absence of prosthetic heart sounds and perhaps a quick echocardiographic study are all that is necessary to substantiate the diagnosis, and operation should be undertaken immediately. Cardiac catheterization in these severely ill patients is probably not necessary, delays the intervention that is required and imposes an inordinate burden on the already desperately overworked myocardium.

We thank Dr. G. Rao who provided us with an echocardiographic study.

References

1. ROBERTS AK, LAMBERT CJ, MITCHEL BF: Embolization of disc occluder of a Wada-Cutter mitral prosthesis with survival. *Ann Thorac Surg* 21: 361, 1976
2. ROE BB, FISHMAN NH, HUTCHINSON JC, et al: Occluder disruption of Wada-Cutter valve prosthesis. *Ann Thorac Surg* 20: 256, 1975
3. WADA J, KOMATSU S, IKEDA K, et al: A new hingeless valve, in *Prosthetic Heart Valves,* BREWER LA 3rd, COOLEY DA, DAVILA JC, et al (eds), Springfield, IL, CC Thomas, 1969, p 304
4. ANSBRO J, CLARK R, GERBODE F: Successful surgical correction of an embolized prosthetic valve poppet: case report. *J Thorac Cardiovasc Surg* 72: 130, 1976
5. DUPRIEST RW JR, SEMLER HJ, OYAMA AA, et al: Sudden death due to dislodgement of disc occluder of Wada-Cutter prosthesis. A case report. *J Thorac Cardiovasc Surg* 66: 93, 1973
6. HUGHES DA, LEATHERMAN LL, NORMAN JC, et al: Late embolization of prosthetic mitral valve occluder with survival following reoperation. *Ann Thorac Surg* 19: 212, 1975

From the divisions of cardiovascular and thoracic surgery and cardiology, University of Alberta Hospital, Edmonton, Alta.

Reprint requests to: Dr. E.T. Gelfand, 8409-112 St., Ste. 550, Edmonton, Alta. T6G 1K6

Long-Term Follow-Up of Triple Arthrodesis

RONALD MONSON, MD, FRCS[C] AND DONALD A. GIBSON, MD, FRCS[C]

Thirty-seven children in whom 46 triple arthrodeses had been performed were followed up for 19 to 33 years (average, 24 years). Better results were evident in patients who had been operated on because of poliomyelitis, pes cavus or pes planus than in patients operated on for club foot, cerebral palsy or spina bifida. The use of staples appeared to improve the result. A neutral position of the heel is desirable. Varus positions required revision in three patients. A heel–toe gait was noticeable in 74% of patients. Osteoarthritis occurred in 24% and pseudarthrosis in 4% of our patients. In 91% of patients the functional result could be described as good or excellent.

On a suivi l'évolution de 37 enfants chez qui on avait effectué 46 arthrodèses triples, pour des périodes allant de 19 à 33 ans (moyenne, 24 ans). Les résultats observés chez les patients qui avaient été opérés à cause de poliomyélite, pied arqué ou pied plat ont été meilleurs que pour les patients avec pied bot, paralysie cérébrale ou spina bifida. L'emploi de broches semble améliorer les résultats. Il est souhaitable de donner une position neutre au talon. Les positions varus ont nécessité une révision chez trois patients. Une démarche talon-orteille était évidente chez 74% des patients. De l'ostéoarthrite est apparue chez 24% des patients et de la pseudarthrose dans 4% des cas. Chez 91% de patients, les résultats fonctionnels peuvent être décrits comme bons ou excellents.

Fifty years have passed since the principles of triple arthrodesis were described by Ryerson.[1] Since then, many short-term, but few long-term, follow-up studies of the operation have been reported.[2-5] The three joints concerned are the talocalcaneal, the talonavicular and the calcaneocuboid, which are fused to give stability, to correct deformity and to relieve pain. Several modifications have been devised, the most notable being that of Lambrinudi[6] for correction of drop foot.

From time to time surgeons are confronted with difficult problems arising from poor results of triple arthrodesis and some have expressed the opinion that the operation is a poor one and should be discarded. We conducted a study to determine the long-term results of triple arthrodesis in patients treated at the Hospital for Sick Children, Toronto, and whether poor results represent the norm or the exception.

Material and Methods

Patients

Of the 402 patients who had a triple arthrodesis in the 15 years from 1942 to 1956 inclusive, 39 could be traced. Two patients were unable to return for follow-up, hence only 37 were re-examined and could be included in the study. In 9 of the 37 the operation had been bilateral, to produce a total of 46 operations. The low rate of follow-up is due to the high mobility of the Canadian population and the long time that had elapsed before any effort was made to trace the patients. Certainly the patients we were able to contact were unselected with respect to whether their operative result was good or bad, and therefore we consider the review of their condition to be meaningful.

The average age at operation was 11.7 years (range, 8 to 15 years). One of three types of arthrodesis was performed: the standard three-joint fusion, the Lambrinudi fusion, or the Hoke fusion.[7]

The average duration of follow-up in all patients was 24 years (range, 19 to 33 years). Thirty operations were performed in boys, 16 in girls.

Assessment of the Long-Term Result

From the clinical records of all patients re-examined we determined the sex, diagnosis, age at operation, preoperative position of the foot, type of operation performed and whether staple fixation had been used.

Functional.—Based on the patient's response to questioning, grading was established as follows:

- Excellent: no limitation of activity, no pain.
- Good: walking unrestricted but some limitation in running; no pain.
- Fair: limitation in walking and mild pain.
- Poor: presence of pain.

Objective.—The grading based on physical examination of the foot and roentgenograms of the foot and ankle was as follows:

- Excellent: all joints fused. Heel and foot normally aligned with no varus or valgus. Heel–toe gait, no osteoarthritis.
- Good: all joints fused. Minimal joint changes. No callosities on the foot.
- Fair: fusion of at least two joints. Mild callosities, incomplete correction of deformity. Mild joint changes.
- Poor: pseudarthrosis of talocalcaneal joint. Marked plantar callosities. Undercorrection, overcorrection, or recurrence of deformity.

Results

The sex of the patient had no influence on the result. The operation produced a better result when the preoperative condition was poliomyelitis, pes planus, or pes cavus than when the patient had cerebral palsy, spina bifida, or a club-foot deformity (Table I).

The age of the patient at the time of the operation affected the degree of

Table I—Objective Result of Triple Arthrodesis

Diagnosis	Excellent	Good	Fair	Poor	Total
Pes cavus	4	1	0	0	5
Pes planus	3	4	0	0	7
Poliomyelitis	10	1	1	0	12
Peripheral neuropathy	1	1	1	0	3
Cerebral palsy	1	1	3	0	5
Club foot	0	4	5	1	10
Spina bifida	0	1	2	1	4
Total	19	13	12	2	46

From the division of orthopedic surgery, the Hospital for Sick Children, Toronto, Ont.

Reprint requests to: Dr. Donald A. Gibson, Division of orthopedic surgery, The Hospital for Sick Children, 555 University Ave., Toronto, Ont. M5G 1X8

success. The result could be classified as excellent or good in 88% of the 18 patients operated on at age 13 years or older. In those operated on at a younger age the result was less satisfactory; in only 54% was it rated as good or excellent.

Staples for internal fixation were used in 23 operations and in 78% of the patients good or excellent results were obtained. In the absence of internal fixation the corresponding figure was 63%. In the two cases of nonunion encountered in the series staple fixation had not been employed. We did not find that staples produced better alignment of the foot.

Lambrinudi triple arthrodeses, though fewer, appeared to give better results than standard triple arthrodeses (Table II). The Lambrinudi procedure was performed in patients who, in all cases but one, had neurologic problems, such as poliomyelitis or muscle imbalance. It was not selected for any patient in this group with club-foot deformity.

Revision of the fusion was required in three patients for undercorrection of the varus deformity of the heel.

In general, good or excellent results were found slightly less often in the patients whose follow-up was of the longest duration (Table III). Seven of 15 patients seen more than 25 years after the operation had mild pain. Ten of 31 patients in whom the interval was less than 25 years had mild pain. The frequency of osteoarthritis in the two groups was the same. A heel–toe gait was observed in 75% of patients, equinus gait in 13%, plantigrade gait in 7%, drop foot in 4% and antalgic gait in 2%.

Roentgenograms verified that pseudarthrosis had developed in two joints, the talocalcaneal in one patient and the calcaneocuboid in another. There was a 24% incidence of osteoarthritis, 20% in the ankle joint and 4% in the tarsal joint. Of the 10 patients with club-foot deformity who had a triple arthrodesis, 7 had osteoarthritis of the ankle joint.

The present position of the foot operated on was found to be normal in 45% of the patients seen on follow-up. If the foot was normally aligned the functional result was good or excellent (Table IV).

The functional results were good or excellent after 42 (91%) of 46 operations. The overall objective results were also good or excellent after 32 (70%) operations.

Discussion

These results indicate that the long-term functional results of triple arthrodesis are good.

Drew,[8] in his long-term study of patients after 31 operations, found full function present in 65% and moderate function in 26%. Thus 91% of his patients had moderate to full function, a result similar to our own. He also noted roentgenographic evidence of osteoarthritis in 10 (32%) of 31 patients. This is slightly higher than the figure of 24% in our series.

Lemperg[4] found a good result in only 10 (24%) of 42 feet he examined after triple arthrodesis for club foot. In our patients with this deformity there was no result that could be classified as excellent and in only 40% was it considered good. These figures reflect the inherent problems in treating a club foot.

Patterson, Parrish and Hathaway[5] found that the standard triple arthrodesis gave good results in 53.9% of their 89 patients; for the Lambrinudi type of triple arthrodesis, the figure was 45.5% of 55 patients. Howland[3] obtained a good or excellent result in 73.4% of 60 patients treated with the standard triple arthrodesis and in 50% of 8 patients subjected to a Lambrinudi fusion.

Friedenberg[2] noted that pseudarthrosis had developed in 20% of 65 patients who had a triple arthrodesis. We noted pseudarthrodesis in only 4% of our cases.

Staples, which formerly were not routinely employed, were used in 23 of the operations we reviewed. They make possible accurate and firm maintenance of the desired position and therefore may be responsible for a decrease in the incidence of pseudarthrosis. There were no pseudarthroses in this group, but, since in the nonstapled group there were only two instances, each of late navicular pseudarthrosis, no conclusion can be drawn.

The slight decrease in the number of good results in patients who were seen after the longest interval from operation is possibly indicative of the alteration in joint mechanics acting over many years.

Conclusions

Ninety-one percent of the operations of triple arthrodesis have been found to furnish a good or excellent functional result when the patients were reviewed 19 to 33 years later. However, if the overall objective result is considered, with attention to position of the foot, gait and roentgenographic appearance, this favourable figure must be reduced to 70%.

We thank the surgeons at the Hospital for Sick Children who allowed us to study their patients, and the surgical studies fund of the Hospital for Sick Children which made this study possible.

References

1. RYERSON EW: Arthrodesing operations

Table II—Objective Result according to Type of Operation

Type of arthrodesis	Excellent	Good	Fair	Poor	Total
Standard	14	9	12	1	36
Lambrinudi	5	3	0	1	9
Hoke	0	1	0	0	1
Total	19	13	12	2	46

Table III—Objective Result according to Length of Interval Since Operation

Follow-up, yr	Excellent	Good	Fair	Poor	Total
19 – 20	3	3	1	1	8
21 – 25	10	7	5	1	23
> 25	6	3	6	0	15
Total	19	13	12	2	46

Table IV—Functional Result

Present position	Excellent	Good	Fair	Poor	Total
Normal alignment	12	9	0	0	21
Pes cavus	0	1	0	0	1
Planovalgus	2	6	1	0	9
Equinus	3	4	1	0	8
Varus	3	1	0	1	5
Pes planus	0	1	1	0	2
Total	20	22	3	1	46

on the feet. *J Bone Joint Surg* 5: 453, 1923

2. FRIEDENBERG ZB: Arthrodesis of the tarsal bones; a study of failure of fusions. *Arch Surg* 57: 162, 1948
3. HOWLAND J: Triple arthrodeses: history, indications, and 10 year statistics. *Am J Orthop* 6: 16, 1964
4. LEMPERG R: Subastragalar triarticular arthrodesis for congenital club foot in children aged 2½ - 15 years. *Acta Orthop Scand* 36: 203, 1965
5. PATTERSON RL, PARRISH FF, HATHAWAY EN: Stabilizing operations on the foot; study of indications, techniques used, and end results. *J Bone Joint Surg* [*Am*] 32: 1, 1950
6. LAMBRINUDI C: New operation of dropfoot. *Br J Surg* 15: 193, 1927
7. HOKE M: An operation for stabilizing paralytic feet. *J Orthop Surg* 3: 494, 1921
8. DREW AJ: The late results of arthrodesis of the foot. *J Bone Joint Surg* [*Br*] 33: 496, 1951

Trichobezoar: An Uncommon Pediatric Problem

RAFAEL REISFELD, MD, WILLIAM DAMMERT, MD AND JAMES S. SIMPSON, MD, FRCS[C], FACS, FAAP

Trichobezoar, the "hair-ball" occasionally found in the stomach of emotionally disturbed adults, particularly women, is an uncommon finding in the pediatric age group. The diagnosis often rests on the suspicion of the alert physician since most patients will not volunteer information about swallowing hair. The presence of a palpable upper abdominal mass associated with progressive intolerance to food, with weight loss and with weakness, and the roentgenographic appearance of a mass after a barium meal confirms suspicion. Treatment consists of laparotomy and gastrotomy to permit removal of the foreign material. Psychiatric assistance should be sought.

Le trichobézoard, cette "balle de cheveux" qui est découverte occasionnellement dans l'estomac d'adultes émotivement dérangés, particulièrement chez les femmes, est peu fréquemment observé chez les patients d'âge pédiatrique. Le diagnostic repose souvent sur les soupçons d'un médecin vigilant puisque les patients n'avouent pas d'eux-mêmes avaler des cheveux. La présence d'une masse palpable dans la partie supérieure de l'abdomen associée à l'apparition progressive d'une intolérance alimentaire, d'une perte de poids et de faiblesse et l'examen radiologique après repas baryté, confirment les soupçons. Le traitement comprend une laparotomie et une gastrotomie afin de permettre de retirer le matériel étranger. Une aide psychiatrique devrait être recherchée.

From the departments of surgery, The Hospital for Sick Children and University of Toronto, Toronto, Ont.

Reprint requests to: Dr. James S. Simpson, 170 St. George St., Toronto, Ont. M5R 2M8

Bezoar is defined as a concretion found in the alimentary canal of animals, especially ruminants, and occasionally in man.[1] The term is derived from the Persian "padzhar", meaning antidote. In olden times bezoars were considered to have magical properties and therefore to be useful as medicinal agents.

There are four main types: trichobezoar, consisting of hair; phytobezoar, composed mainly of vegetable fibres (skin and seeds); trichophytobezoar, a combination of hair and vegetable matter; and concretions, usually composed of foreign substances such as shellacs.

The diagnosis of trichobezoar is uncommon, particularly in the pediatric age group. It is of interest that we have recently encountered two such cases.

Case Reports

Case 1. — A 16-year-old girl was admitted because of anorexia, weight loss, thinning of the hair and amenorrhea for 4 months. For the last 3 weeks she had experienced intermittent epigastric pain and nausea, which had prevented her attending school. She had not vomited, and the rest of her medical history and the family history were noncontributory.

The girl was thin but in no distress. Her scalp hair was thin and sparse, but she emphatically denied trichophagia. The only positive physical finding was a palpable epigastric mass (diameter, approximately 15 cm) that was firm, slightly tender, irregular and movable; no bruits were audible. Results of laboratory investigations were normal.

The tentative diagnosis was liver tumour, but a roentgenogram obtained during intravenous pyelography revealed a trichobezoar (Fig. 1). Psychiatric consultation preoperatively revealed no obvious mental disorders; the patient's intellectual level was considered to be low normal.

Laparotomy was performed and a large trichobezoar extracted through the gastrotomy (Figs. 2 and 3). Apart from su-

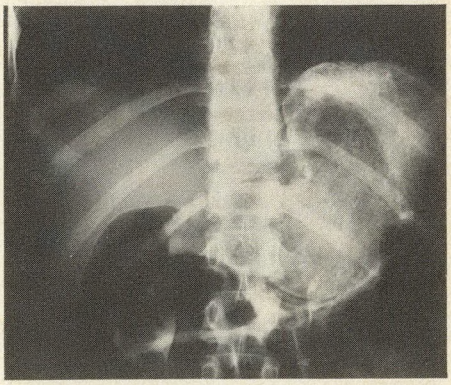


FIG. 1—Gastrografin demonstration of trichobezoar in stomach.

FIG. 2—Trichobezoar extruding through gastrotomy.

perficial wound infection, the patient's recovery was uneventful.

Case 2. — A 6-year-old girl was referred because her mother was concerned about the child's habit of eating her hair and that of her doll. Areas of alopecia were noticeable but she had no symptoms related to her curious eating habits. She appeared well adjusted and was at her expected level at school. On examination there was a firm epigastric mass in the abdomen that was movable and nontender. A barium roentgenographic examination of the stomach outlined an amorphous-looking mass extending from the fundus to the pylorus; this was interpreted as a trichobezoar. At laparotomy and gastrotomy a large hairy mass, the shape of the stomach, was removed. She had an uneventful recovery with no signs of wound infection. Her mother later reported that her appetite had improved and that the habit of eating her hair seemed to have been broken.

Discussion

Trichobezoar, the commonest form of bezoar, is found chiefly in women over 20 years of age. The most often cited cause is some form of emotional disturbance. The mechanism of its formation is not certain, but that proposed by Meilchen in 1911 is widely accepted.[2,3] He theorized that hair strands became retained and attached in the folds of the gastric mucosa because the friction surface is insufficient for propulsion by peristalsis.

The diagnosis of trichobezoar is suggested by a history of hair ingestion, a palpable epigastric mass, upper abdominal pain, the presence of hair in vomitus, progressive intolerance of solid foods, weight loss, weakness and inanition. Obstructive jaundice has been reported.[4] Suspicion of the diagnosis depends on the physician's alertness, since few patients voluntarily give a history of trichophagia[5-8] and, like our first patient, may deny it on questioning.

FIG. 3—Specimen after removal.

Examination may discover pallor, nervousness, malnutrition and a relatively mobile epigastric mass. The diagnosis can be established radiologically as in these cases, or by gastroscopy.[9]

The treatment is laparotomy with gastrotomy and removal of the foreign material.[5] The surgeon should also search the small intestine for residual hair balls that might cause obstruction, hemorrhage, ulceration, perforation or peritonitis. Recovery is usually uneventful.[6] Psychiatric evaluation is desirable and treatment of emotional disorders should be instituted.

Trichobezoar is uncommon in children, in whom the condition may remain undiagnosed for a long time.[10] These case reports are intended to alert pediatricians and surgeons to this possibility.

References

1. STEDMAN TL: *Stedman's Medical Dictionary,* 21st ed, ASIMOV I, et al (eds), Baltimore, Williams & Wilkins, 1966
2. DEBAKEY M, OCHSNER A: Bezoars and concretions; comprehensive review of literature with analysis of 303 collected cases and presentation of 8 additional cases. *Surgery* 4: 934, 1938
3. Idem: Bezoars and concretions; comprehensive review of literature with analysis of 303 collected cases and presentation of 8 additional cases. *Surgery* 5: 132, 1939
4. SCHREIBER H, FILSTON HC: Obstructive jaundice due to gastric trichobezoar. *J Pediatr Surg* 11: 103, 1976
5. KUTTY MK, MENON KA: Trichophytobezoar. *Aust NZ J Surg* 43: 184, 1973
6. TONDREAU RL, KIRKLIN BR: Symposium on abdominal surgery; bezoars of stomach. *Surg Clin North Am* 30: 1097, 1950
7. OSMOND JD JR, PRICE JB: Perforation of gastric ulcer secondary to trichobezoar; report of a case in which patient survived. *JAMA* 145: 818, 1951
8. HOYT CS, BURKE EC, HALLENBECK GA: Trichobezoar. *Mayo Clin Proc* 33: 298, 1958
9. NAUER E, FILIPPINI L: Zur Therapie von Magenbezoaren. *Dtsch Med Wochenschr* 100: 1602, 1975
10. HALEY AE: Bezoars. *Ann Intern Med* 46: 30, 1957

in Acute Pancreatitis

in Hyperfibrinolytic Hemorrhages

Trasylol®

FBA

Survival in Colorectal Cancer

LUC DESCHÊNES, MD, FRCS[C], JACQUELINE FABIA, MD, SD(HYG), YVAN DOUVILLE, MD AND CLAUDE DUFOUR, MD

The authors studied the hospital records of 258 patients with colorectal cancer diagnosed between 1965 and 1974 at l'Hôpital du Saint-Sacrement, Quebec and computed expected and relative survival rates to adjust for deaths from other causes. Life-table methods based on full intervals only were used to analyse survival.

The patients (138 men and 120 women) ranged in age from 24 to 96 years (mean, 64.9 ± 12.7 years). The 5-year relative survival rate expressed as a percentage was 48.6 ± 4.7 for the total group and 64.1 ± 5.6 for patients in stages A, B and C of Dukes' classification. The overall operative mortality rate of 2.7% compared favourably with that reported elsewhere. Among patients with cancer of the sigmoid colon or rectum (the most readily detectable), the diagnosis was made at stage A in one out of nine and at stage D in approximately one out of four. Despite the introduction of universal medical insurance in Quebec in 1970, there has been no significant trend towards earlier diagnosis.

La survie de 258 patients atteints de cancer colorectal diagnostiqué à l'Hôpital du Saint-Sacrement, Québec de 1965 à 1974 compris a été étudiée par la méthode actuarielle basée sur des intervalles annuels complets. L'ajustement pour les décès par autres causes a été obtenu en calculant les taux de survie espérés et relatifs.

L'âge des malades (138 hommes et 120 femmes) variait de 24 à 96 ans avec une moyenne de 64.9 ± 12.7. Le taux de survie relatif (%) a été 48.6 ± 4.7 pour le total des patients et 64.1 ± 5.6 pour ceux porteurs d'un cancer au stade A, B ou C de Dukes. La mortalité opératoire globale (2.7%) se compare favorablement à celle rapportée ailleurs. Parmi les malades atteints de cancer du sigmoïde ou du rectum (les plus facilement détectables), un sur neuf a été diagnostiqué au stade A et environ un sur quatre au stade D. Malgré l'introduction, en 1970, de l'assurance maladie couvrant toute la population du Québec, il ne s'est manifesté aucune tendance significative vers un diagnostic plus précoce.

From the department of surgery, Hôpital du Saint-Sacrement and the department of social and preventive medicine, Laval University, Quebec, PQ

Reprint requests to: Dr. L. Deschênes, Department of surgery, Hôpital du Saint-Sacrement, 1050 Ste-Foy, Quebec, PQ K1S 4L8

In Quebec, as well as in Canada as a whole, colorectal cancer is the second most frequent cause of death by cancer for both sexes, being next in order to lung cancer in men and breast cancer in women.

We have previously reported the survival experience of breast cancer patients.[1] Our present purpose is to describe the survival of patients with colorectal cancer admitted to our hospital.

Methods

Sources of Data and Period of Study

The records were reviewed of all patients in whom colorectal cancer was first diagnosed from Jan. 1, 1965 to Dec. 31, 1974 at the Hôpital du Saint-Sacrement, Quebec City. Also reviewed were the records from the tumour clinic supervising follow-up and from the department of histopathology. Death certificates filed at the Quebec population registry were also searched.

Follow-up continued to Dec. 31, 1975. All patients known to be still alive were contacted at the close of the study. There were no losses to follow-up.

Criteria for Entry into Study

Entry into the study was restricted to patients who had not previously received any treatment for cancer in accordance with the criteria used by the end results group of the United States National Cancer Institute.[2]

Survival

Survival was measured from the date of the first hospitalization during which colorectal cancer was diagnosed. Life-table methods[3] based on full intervals[4] only were used to analyse survival. As recommended by Drolette,[4] patients due to withdraw because the study was being terminated were removed at the start of the interval and not during it.

Deaths from all causes were included in the analysis.[5] The necessary adjustment for mortality from causes other than colorectal cancer and for association between age and risk of death from other causes was provided by computing the relative survival rate.[6]

The relative survival rate is defined as the ratio of the observed survival rate to the survival rate expected over the same period of time in a group of persons from the general population with the same age and sex distribution as the patients.[5]

The expected survival rates were computed from the 1970-72 sex-specific life tables for the population of the Quebec City region,[7] since 92% of the patients in this series came from this region.

The standard error of the observed survival rate was computed from Greenwood's formula[8] and was divided by the expected survival rate to obtain the standard error of the relative survival rate.[5]

Site

Cancers located within 15 cm of the pectinate line were classified as rectal.

Assessment of the Extent of Disease

Assessment of the extent of disease was based on all information available at first hospital discharge.[2] Disease was divided into four stages: A (lesion confined to the bowel wall), B (lesion reaching the serosa or pericolic fat) and C (lymph-node involvement) according to Dukes' classification,[9] and a stage D that included cases with distant metastases.

For patients with synchronous lesions at different stages, the extent of disease was regarded as that of the most advanced lesion.

Results

The age distribution of the 258 patients included in the study appears in Fig. 1. There were 138 men and 120 women. For men, age ranged from 24 to 96 years (mean, 64.8 ± 12.9 years; median, 65.7 years). For women, the age range was 24 to 93 years (mean, 64.8 ± 13.5 years; median, 66.2 years). The sex distribution of patients by site is illustrated in Fig. 2. As is usually observed,[10-13] there were more women among the 178 patients with cancer of the colon and more men among the 74 patients with cancer of the rectum. Six patients had synchronous tumours. The diagnosis was confirmed histologically in all patients.

The overall proportion of patients with localized disease (stages A and B) was 47.3% whereas that of patients with lymph-node involvement was 29.8%. Among patients with cancer of the sigmoid colon or rectum (i.e., the most readily detectable), the diagnosis was made at stage A in one of nine, whereas approximately one in four had evidence of distant spread of the disease at the time of diagnosis. The distribution according to stage did not vary for the different sites (Table I).

The distribution of patients according to stage of disease among those entering the study from 1965 to 1969 did not differ significantly from the distribution among those admitted from 1970 to 1974. From the first period to the second, however, there was a decrease in the proportion of stage B patients from 47.3% to 33.6% and an increase in the proportion of stage A and stage D patients from 4.5% to 10.3% and 18.7% to 25.3%, respectively.

There was no association between mean or median age and the extent of disease (Table II). Patients with stage A or stage C lesions were on the average younger than those with lesions classified as stage B or D.

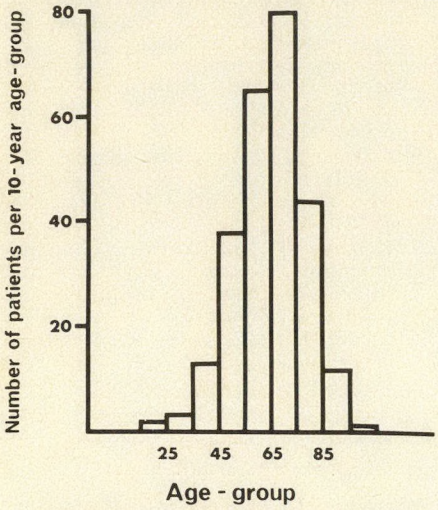


FIG. 1—Age distribution of 258 patients with colorectal cancer.

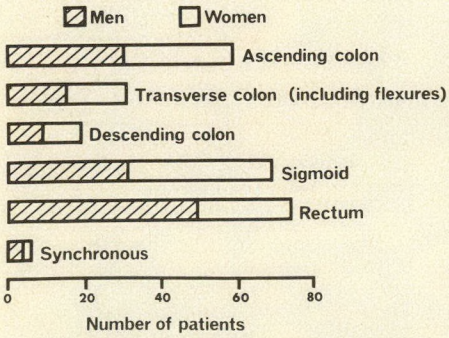


FIG. 2—Sex distribution of patients by site of lesion.

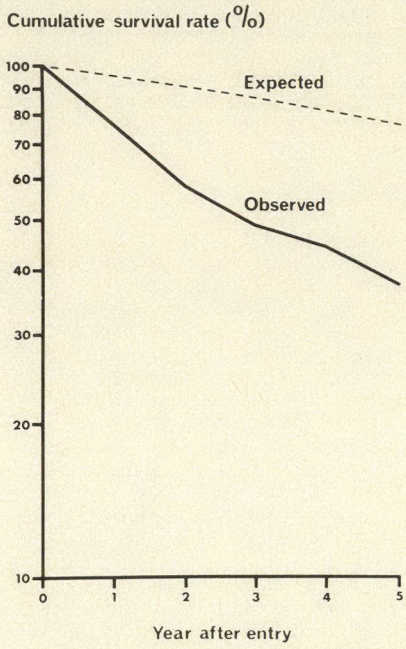


FIG. 3—Observed and expected survival rates, 1965 through 1975, all stages.

The observed and expected cumulative survival rates are plotted semilogarithmically in Fig. 3. The two curves diverge greatly, leading to a 5-year observed cumulative survival rate of 37.3% ± 3.6% and an expected survival rate of 76.8%. The 5-year relative survival rate was 48.6% ± 4.7%. The observed probability of death was highest (0.244) in the second year after entry and was also very high (0.233) in the first year.

Surgery was performed on 257 of the 258 patients. It was considered to be "curative" for 162 (63%) patients and palliative for 95 (37%). Seven patients died within 30 days of surgery: one patient with a stage A lesion, one with a stage C lesion and five with distant metastases. The total operative mortality rate (2.7%) in our series as well as the operative mortality in the group of patients who underwent resection in the hope of cure (1.2%) compare favourably with the rates reported by other authors for patients in whom the diagnosis had been made in earlier years.[11,13-18]

When only patients in stages A, B and C are included in the analysis, the 5-year observed and relative cumulative survival rates are 49.0% ± 4.3% and 64.1% ± 5.6%, respectively.

Two-year cumulative survival rates by stage of disease appear in Table III. As always, observed and relative rates decreased significantly with increasing extent of disease, ranging from 95.0% ± 4.9% and 99.4% ± 5.1% for stage A to 21.3% ± 5.6% and 23.2% ± 6.1% for stage D. Because of small

Table II—Median and Mean Ages at Entry and Age Range for Patients in Study* according to Extent of Disease

Stage	Median age, yr	Mean age, yr	Standard deviation, yr	Range, yr
A (n = 20)	63.0	62.1	10.6	33–82
B (n = 102)	67.4	66.3	12.7	24–89
C (n = 77)	62.7	62.6	13.6	24–96
D (n = 58)	67.5	66.2	13.0	30–93

*Excludes 1 patient of undetermined stage.

Table I—Distribution of Patients by Site and Extent of Disease

Stage	Site: Ascending colon, no. (and %)	Transverse colon, no. (and %)	Descending colon, no. (and %)	Sigmoid colon, no. (and %)	Rectum, no. (and %)	Total,* no. (and %)
A	1	1	1	7	9	20 (7.8)
B	25 (44.1)	16 (54.8)	8 (47.4)	25 (46.4)	25 (45.9)	102 (39.5)
C	20 (33.9)	7 (22.6)	6 (31.6)	16 (23.2)	26 (35.1)	77 (29.8)
D	13 (22.0)	7 (22.6)	4 (21.0)	21 (30.4)	13 (17.6)	58 (22.5)
Undetermined	— —	— —	— —	— —	1 (1.4)	1 (0.4)
Total	59 (100.0)	31 (100.0)	19 (100.0)	69 (100.0)	74 (100.0)	258 (100.0)

*Includes 6 patients with synchronous tumours (stage A: 1 patient, stage B: 3 patients, stage C: 2 patients).

Table III—Two-Year Observed and Relative Cumulative Survival Rates by Extent of Disease

Stage	2-year cumulative survival, %	
	Observed	Relative
A	95.0 ± 4.9	99.4 ± 5.1
B	72.8 ± 4.8	80.0 ± 5.3
C	58.5 ± 5.7	63.5 ± 6.2
D	21.3 ± 5.6	23.2 ± 6.1

numbers and large standard errors, survival by stage of disease is not given beyond 2 years of follow-up.

Discussion

The overall 5-year relative survival rate for our patients with colorectal cancer is close to the rates reported by Cutler, Myers and Green[19] for the very large sample of patients included in the US end results study.

Survival in the end results study improved little over time. For cancer of the colon, the 5-year relative survival rate was 44% for patients admitted in the period 1950 to 1959 and 45% for those admitted in the period 1965 to 1969. For cancer of the rectum, the corresponding figures were 40% and 41%.

While sex, age, site, local vessel invasion and histologic grade influence survival, the variable with the greatest impact is the extent of disease.[20] The static overall survival in the end results study reflects a depressing stability in the distribution of patients by stage of disease: the proportion of patients in whom colorectal cancer was diagnosed at the localized stage increased from 42.2% in the period 1950 to 1959 to only 43.1% in the period 1965 to 1969.[12] The percentage of patients with distant metastases remained well over 20%.[12]

In our study, there has been no significant trend towards earlier diagnosis despite the introduction of universal medical insurance in Quebec in 1970. However, the increase over time in the proportion of stage A patients, though not significant, may be a hopeful sign.

Several authors, in particular Botsford, Aliapoulios and Fogelson[11] and Péloquin[13] have commented upon and deplored the large numbers of patients in whom the diagnosis is not made until an incurable stage is reached. Although the trends in stage distribution may be somewhat clouded by shifts in the criteria for stage classification together with more accurate ascertainment of the extent of disease, the fact is that the proportion of patients in whom the diagnosis is delayed until very late in the disease remains high. In view of the apparent lack of association between stage and reported duration of symptoms noted by Keddie and Hargreaves[21] and by MacLeod and colleagues,[10] efforts should be made towards early detection of asymptomatic lesions particularly for the easily accessible rectal cancer. Routine rectal examination for all individuals in high-risk age groups coming to the physician for any reason may be the only hope of improving prognosis.

We acknowledge the help of Drs. P. Auger, R. Côté, J. Couture, C. Fortin, H.-P. Noël and E. Poulin of the department of surgery; J. La Vertu, P. Côté and D. Lambert of the tumour clinic and the staff of the medical records section, Hôpital du Saint-Sacrement; Dr. J.-M. Fredette of the Quebec Population Registry and W. Morin of the department of social and preventive medicine, Laval University.

References

1. Deschênes L, Fabia J: Survival in breast cancer: study of 283 patients. *Can J Surg* 19: 60, 1976
2. Cutler SJ, Ederer F (eds): End results in cancer, in *End Results and Mortality Trends in Cancer. Part 1.* National Cancer Institute (monograph 6), Washington, Government Printing Office, 1961, pp 1-6
3. Berkson J, Gage RP: Calculation of survival rates for cancer, *Mayo Clin Proc* 25: 270, 1950
4. Drolette ME: The effect of incomplete follow-up. *Biometrics* 31: 135, 1975
5. Ederer F, Axtell LM, Cutler SJ: The relative survival rate: a statistical methodology, in *End Results and Mortality Trends in Cancer,* op cit, pp 101-121
6. Berkson J: The calculation of survival rates, in *Carcinoma and Other Malignant Lesions of the Stomach,* Walters W, Gray HK, Priestley JT (eds), Philadelphia, Saunders, 1942, p 467
7. Statistiques des Affaires sociales du Québec: *Démographie, Vol. 2, No. 3,* Québec, l'Editeur Officiel du Québec, 1974, p 152
8. Greenwood M: The errors of sampling of the survivorship tables, in *Reports on Public Health and Medical Subjects,* no. 33, appendix 1, London, HMSO, 1926
9. Dukes CE, Bussy HJ: The spread of rectal cancer and its effect on prognosis. *Br J Cancer* 12: 309, 1958
10. MacLeod HJ, Chipman ML, Gordon PC, et al: Survivorship following treatment for cancer of the colon and rectum. *Cancer* 26: 1225, 1970
11. Botsford TW, Aliapoulios MR, Fogelson FS: Results of treatment of colorectal cancer at the Peter Bent Brigham Hospital from 1960 to 1965. *Am J Surg* 121: 398, 1971
12. Axtell LM, Cutler SJ, Myers MH (eds): *End Results in Cancer/Report No. 4,* Bethesda, US Dept of Health, Education, and Welfare, National Institutes of Health, National Cancer Institute, 1972, pp 51-71
13. Péloquin AB: Le cancer du côlon et du rectum au Québec: étude de 1,221 cas selon la localisation (1942-1965). *Union Med Can* 102: 85, 1973
14. Corman ML, Swinton NW, O'Keefe DD, et al: Colorectal carcinoma at the Lahey Clinic, 1962-1966. *Am J Surg* 125: 424, 1973
15. Weir JA: Cancer of the colon in South Saskatchewan. A population study. *Cancer* 31: 616, 1973
16. Gilbertsen VA: The earlier diagnosis of adenocarcinoma of the large intestine. A report of 1,884 cases, including 5-year follow-up survival data, results of surgery for the disease, and effect on survival prognosis of treatment earlier in the development of the disease. *Cancer* 27: 143, 1971
17. Lanier AP, Wychulis AR, Dockerty MB, et al: Colorectal cancer in Rochester, Minnesota 1940-1969. *Cancer* 31: 606, 1973
18. Berge T, Ekelund G, Mellner C, et al: Carcinoma of the colon and rectum in a defined population. An epidemiological, clinical and post-mortem investigation of colorectal carcinoma and coexisting benign polyps in Malmö, Sweden. *Acta Chir Scand* [*Suppl*] 24, 1973
19. Cutler SJ, Myers MH, Green SB: Trends in survival rates of patients with cancer. *N Engl J Med* 293: 122, 1975
20. Godwin JD 2nd, Brown CC: Some prognostic factors in survival of patients with cancer of the colon and rectum. *J Chronic Dis* 28: 441, 1975
21. Keddie N, Hargreaves A: Symptoms of carcinoma of the colon and rectum. *Lancet* 2: 749, 1968

BOOKS RECEIVED

continued from page 247

Gynecologic Operations. As Performed by Members of the Staff of the Women's Hospital, St. Luke's Hospital Center, New York. Harold M.M. Tovell and Leonard D. Dank. 321 pp. Illust. Harper & Row, Publishers, Hagerstown, 1978. $30. ISBN 0-06-142553-2.

Hamilton Bailey's Emergency Surgery. 10th ed. Edited by Hugh A.F. Dudley. 1017 pp. Illust. John Wright & Sons Ltd., Bristol; Year Book Medical Publishers, Inc., Chicago, 1977. $49.50. ISBN 0-8151-2927-0.

The Hip. Proceedings of the Fifth Open Scientific Meeting of The Hip Society, 1977. The Hip Society. 291 pp. Illust. The C.V. Mosby Company, Saint Louis, 1977. $39.25. ISBN 0-8016-0038-3.

Jamieson & Kay's Textbook of Surgical Physiology. 3rd ed. Iain McA. Ledingham and Colin MacKay. 381 pp. Illust. Churchill Livingstone, Edinburgh; Longman Canada Limited, Don Mills, 1978. $57.60. ISBN 0-443-01051-X.

A Manual of Neurosurgery. Marshall B. Allen, Jr., Gernot S. Doetsch, R. Arthur Gindin and others. 282 pp. Illust. University Park Press, Baltimore, 1977. $24.95, paperbound. ISBN 0-8391-1174-6.

The McDowell Indexes of Plastic Surgical Literature. Edited by Frank McDowell. Volume V. The Honolulu Index of Plastic Surgery. Worldwide. 1971 A.D. to 1976 A.D. 849 pp. The Williams & Wilkins Company, Baltimore; Burns & MacEachern Limited, Don Mills, 1977. $103.50. ISBN 0-683-06960-8.

continued on page 267

Mortalité dans le traitement chirurgical d'urgence des hémorragies digestives hautes par ulcères et gastrites

CLAUDE DUFOUR, MD* ET MARCEL J. RHEAULT, MD, M SC, FRCS[C], FACS†

Soixante-huit cas d'hémorragies digestives hautes opérés d'urgence ont été évalués rétrospectivement, à la recherche des facteurs pouvant influencer le taux de mortalité opératoire et la fréquence des récidives hémorragiques. L'étude a exclu les hémorragies secondaires aux varices oesophagiennes. Un taux global de mortalité opératoire de 29.5% a été observé. L'âge des patients et le type d'intervention chirurgicale ne semblent pas avoir influencé ce taux, alors que la chronicité des lésions et une localisation duodénale l'ont affecté favorablement. Le choc hypovolémique et ses complications ont causé la grande majorité des décès. La résection gastrique avec vagotomie a semblé être l'opération de choix en terme de contrôle de l'hémorragie. Après une brève revue de la littérature, les auteurs insistent sur l'importance du diagnostic et de la réanimation précoces, de même que sur la nécessité d'un traitement chirurgical agressif.

A retrospective study of 68 patients with acute upper gastrointestinal bleeding (excluding bleeding from esophageal varices) revealed that all patients had emergency surgery. The factors influencing the mortality and the recurrent bleeding have been sought.

The overall mortality was 29.5%. Age of patients and type of surgical procedure did not affect the mortality rate, while chronicity of lesions and their duodenal location had a favourable influence. Most deaths were due to hypovolemic shock and its complications. Gastric resection with vagotomy is the operation of choice for control of bleeding. The authors present a brief review of the literature and stress the importance of early diagnosis and resuscitative measures, as well as the need for aggressive surgical intervention.

Les opérations pratiquées d'urgence pour hémorragies digestives secondaires aux ulcères aigus duodénaux ou gastriques et aux gastrites aiguës, sont entachées d'une mortalité quasi prohibitive. Il est fréquent de retrouver dans la littérature médicale des taux de mortalité se rapprochant de 30%.[1-3] Depuis quelques années, à l'Hôtel-Dieu de Montréal, nous avions l'impression que le nombre d'hémorragies digestives nécessitant une opération d'urgence augmentait de façon sensible. Nous avons donc décidé de revoir notre expérience des 10 dernières années et nos résultats dans ce domaine.

Méthodes et patients

Cette étude porte sur toutes les opérations pratiquées d'urgence pour hémorragies digestives hautes par ulcères et gastrites à l'Hôtel-Dieu de Montréal, entre le 1er janvier 1966 et le 31 octobre 1975, soit sur une période de près de 10 ans. Elle inclut les hémorragies compliquant les ulcères duodénaux, les ulcères gastriques primaires et secondaires, les ulcères peptiques, récidivants ou anastomotiques, les ulcères aigus et de stress et enfin les gastrites aiguës hémorragiques. Elle exclut les hémorragies secondaires aux varices oesophagiennes et enfin les opérations pratiquées électivement après qu'une hémorragie digestive haute secondaire à une des causes précitées se soit tarie. L'étude couvre tous les genres d'interventions depuis la gastrotomie et la simple ligature de l'ulcère hémorragique, à la résection gastrique avec vagotomie. Les opérations d'urgence ont été pratiquées par les 14 chirurgiens du service ou par les résidents, et sans discrimination de la qualité des patients qu'ils aient été d'un secteur privé ou public. Les résultats ont été soumis à des tests de χ^2 pour déterminer leur valeur statistique.

Soixante-huit patients ont répondu aux critères définis pour notre étude. La moyenne d'âge était de 59 ans; 34 patients avaient plus de 60 ans. On comptait deux hommes pour une femme.

Vingt-six patients n'avaient aucun antécédent de maladie ulcéreuse et les 42 autres patients donnaient une anamnèse d'ulcère symptomatique. Dix-huit patients avaient présenté des hémorragies antérieures et, de ceux-ci, 12 avaient eu un seul épisode hémorragique, 2 avaient eu deux épisodes, 3 avaient eu trois épisodes et 1 avait eu quatre épisodes. Quatre patients de cette série avaient déjà eu une perforation pour laquelle ils avaient été opérés.

Les opérations pratiquées chez nos 68 patients peuvent se répartir en quatre groupes: les résections sans vagotomies (20 patients), les résections avec vagotomies (18 patients), les vagotomies avec pyloroplasties (16 patients) et, enfin, les gastrotomies avec ligatures de l'ulcère hémorragique, mais sans vagotomie (14 patients).

Résultats

Etude de la mortalité

La mortalité opératoire, définie comme celle survenant dans les 30 jours postopératoires, s'est élevée à 29.5%, soit 20 décès. Le taux de mortalité pour les 5 premières années de notre étude était de 23%, soit 5 décès chez 22 patients. Il ne s'est pas amélioré dans les 5 dernières années, malgré une augmentation du chiffre total des cas opérés d'urgence, il est même monté à 33%, soit 15 décès chez 46 opérés d'urgence.

Mortalité selon l'âge

Dans notre série, l'âge des patients ne semble pas avoir été un facteur important dans la mortalité. Dans le groupe de patients qui avaient moins de 60 ans, on trouve 12 décès pour un taux de mortalité de 35%, alors que dans le groupe de 60 ans et plus, on compte seulement 8 décès pour un

Présenté au symposium sur les ulcères gastroduodénaux, tenu à Québec les 21-22 novembre 1975, sous la direction des départements de médecine et de chirurgie de l'Université Laval et sous l'égide du Collège royal des médecins et chirurgiens du Canada

**Résident en chef, département de chirurgie, Hôtel-Dieu de Montréal, Université de Montréal, Montréal, PQ*

†*Professeur agrégé, département de chirurgie, Hôtel-Dieu de Montréal, Université de Montréal*

Les demandes de tirés à part doivent être adressées au Dr M.J. Rheault, Hôtel-Dieu de Montréal, 3840, rue St-Urbain, Montréal, PQ H2W 1T8

taux de 23%. Cette différence n'a aucune valeur statistique significative lorsqu'elle est soumise à un test de χ^2.

Mortalité selon les antécédents cliniques

Théoriquement, le taux de mortalité aurait dû être négligeable dans le groupe de patients sans antécédent de maladie ulcéreuse. Il n'en fut rien, 13 patients de ce groupe sont décédés, pour une mortalité de 50%. Dans le groupe de 42 patients ayant une anamnèse d'ulcère symptomatique, 7 sont décédés pour une mortalité de 17%. Cette différence est statistiquement significative ($\chi^2 = 8.4$, $P < 0.005$); avec la correction de Yate pour les petits nombres χ^2 est 6.9 et $P < 0.01$. Chez 42 patients, on retrouvait les facteurs prédisposants classiques, soit la prise de médicaments, les opérations antérieures ou l'ingestion d'alcool. Quatorze patients de ce groupe sont décédés pour une mortalité de 33%.

Mortalité selon le diagnostic

Dans la littérature, on retrouve des différences de taux de mortalité selon le diagnostic étiologique de l'hémorragie. Les ulcères duodénaux ont un meilleur pronostic que les ulcères gastriques ou les gastrites aiguës. Trente-cinq patients avaient un ulcère duodénal et leur mortalité a été de 17%, soit six décès. Vingt-trois patients porteurs d'un ulcère gastrique ont eu une mortalité de 39%, soit neuf décès, alors que les huit patients ayant souffert de gastrite ont eu une mortalité de 37%, soit trois décès. Au test du χ^2 ces résultats ne montrent pas de différence statistiquement significative.

Mortalité selon le type d'intervention

Dans les quatre groupes définis précédemment on note immédiatement que les patients qui ont subi une résection gastrique étaient en moyenne plus jeunes de 3 ans comparativement à ceux qui ont subi une vagotomie avec drainage et de 8 ans comparativement à ceux qui n'ont subi qu'une gastrotomie.

La mortalité varie beaucoup entre ces groupes (Tableau I). Dans le premier groupe (résection sans vagotomie), 9 des 20 patients sont décédés pour un taux de 45%. Dans le deuxième groupe (résection et vagotomie), 2 seulement des 18 patients opérés sont décédés pour un taux de 11%. Dans le troisième groupe (vagotomie et pyloroplastie), on compte 5 décès chez 16 patients pour un taux de 31% et dans le dernier groupe (gastrotomie sans vagotomie), 4 décès chez 14 patients pour un taux de 29%. On note que l'intervalle entre l'hospitalisation et l'opération est beaucoup plus court dans le groupe qui a le taux de mortalité le plus bas, soit 88 heures en comparaison de 100 et 102 heures. Aucun de ces résultats, soumis au test de χ^2, n'a montré une différence statistiquement significative.

Récidive hémorragique

Un seul groupe n'a pas présenté de récidive hémorragique, soit les 18 patients qui ont eu une résection gastrique accompagnée d'une vagotomie. Les 20 patients qui ont eu une résection sans vagotomie ont eu un taux de récidive hémorragique de 15%, soit 3 patients. Les 16 patients qui ont eu une vagotomie avec pyloroplastie ont eu 4 récidives pour un taux de 25%. Les gastrotomies simples avec ligature ont un taux de récidive de 36%, soit 5 récidives chez 14 patients. Certains de ces résultats sont statistiquement significatifs. La vagotomie avec résection comparée à la gastrotomie simple et ligature montre une différence avec une valeur du $P < 0.02$. Egalement, la vagotomie avec résection comparée à la vagotomie avec drainage montre une différence significative quant au taux de récidive hémorragique ($P < 0.05$). Si on regroupe les patients qui ont eu une vagotomie, on retrouve 34 patients dont 4 ont resaigné, soit 11.1%. Si on étudie ceux qui n'ont pas eu de vagotomie, on retrouve 8 récidives hémorragiques chez 34 patients pour un taux de 23.5%, soit le double, mais ces résultats ne sont pas statistiquement significatifs.

Causes de décès

Une étude des causes de décès nous révèle que 13 patients sont morts d'une perte sanguine insuffisamment compensée: 10 ont présenté une exsanguination avec choc irréversible et 3 sont morts d'insuffisance rénale. Six autres patients sont morts d'une atteinte pulmonaire et un, à la suite d'un déséquilibre électrolytique secondaire, à une obstruction de l'anastomose. Dans cette série, 32 patients ont présenté au moins un épisode de choc et de ce nombre, 13 sont décédés, soit une mortalité de 40.6%. En moyenne, nos patients ont reçu 11 unités de sang avant d'être opérés. Le nombre de décès a été proportionnel à la faiblesse de l'hématocrite en préopératoire (Tableau II).

Discussion

Dans un hôpital général, les hémorragies digestives hautes par ulcères et gastrites aiguës sont fréquentes. Heureusement, la très grande majorité se tarit spontanément avec un traitement médical conservateur. La chirurgie d'urgence n'est utilisée que chez un faible pourcentage de patients. Nous n'avons pas fait la revue de toutes les hémorragies digestives hautes traitées à l'Hôtel-Dieu de Montréal pendant la période de 10 ans couverte par l'étude. Cependant, une étude d'une durée de 20 mois a été faite en 1970 et 1971 par le docteur Clermont, à l'Hôtel-Dieu de Montréal.[4] Il a comparé l'abord diagnostique vigoureux par endoscopie immédiate, à l'attitude traditionelle conservatrice. Pendant cette période, 153 patients ont été traités et 27 (18%) ont eu une sanction chirurgicale, soit urgente, soit retardée après arrêt de l'hémorragie. De ce groupe 10 patients ont été opérés d'urgence et aucun n'est décédé des suites opératoires. Ces résultats ne peuvent se comparer à l'ensemble de nos résultats. On serait tenté de conclure que la solution pour diminuer la mortalité chirurgicale des hémorragies digestives hautes consiste à adopter une attitude agressive quant au diagnostic endoscopique. Une étude prospective et randomisée, émanant du Michael Reese Hospital and Med-

Tableau II—Taux d'hématocrite préopératoire et mortalité

Hématocrite en préopératoire, %	No. de patients	No. dèces (et %)
< 25	38	15 (39.5)
25 - 30	23	4 (17.4)
> 30	7	1 (14.3)

Tableau I—Hémorragies digestives opérées d'urgence. Hôtel-Dieu de Montréal 1966 à 1975

Opération	No. de patients	No. dèces (et %)	Moyen âge, an	Unités de sang reçues	Intervalle entre l'hospitalisation et la chirurgie, h	No. récidives hémorragiques (et %)
Résection sans vagotomie	20	9 (45)	56.5	11	146	3 (15)
Résection avec vagotomie	18	2 (11)	57	12	88	0 (0)
Vagotomie et pyloroplastie	16	5 (31)	60	11	100	4 (25)
Gastrotomie sans vagotomie	14	4 (29)	64.5	10	102	5 (36)

ical Center de Chicago, a montré que cet abord n'a nullement diminué la mortalité opératoire dans cette institution, où elle est demeurée à 30% chez 20 patients opérés d'urgence.[1]

Des articles publiés depuis 1973 ont signalé des taux de mortalité aussi élevés que ceux retrouvés à l'Hôtel-Dieu de Montréal. Crook et ses collaborateurs[3] du Louisiana State University, ont rapporté une mortalité de 31% dans leurs résultats d'opérations d'urgence pour hémorragies digestives hautes. Yajko, Norton et Eiseman,[2] du Denver General Hospital ont rapporté une mortalité opératoire de 29%. Sandlow et ses collaborateurs,[1] du Michael Reese Hospital and Medical Center de Chicago, ont signalé un taux de mortalité de 30% dans les mêmes circonstances. Ces résultats corroborent les nôtres et montrent que malgré les progrès de la médecine et de la chirurgie, les opérations d'urgence pour hémorragies digestives massives hautes, sont grevées d'une mortalité très élevée.

Dans notre série, l'âge des patients ne semble avoir joué aucun rôle quant au taux de mortalité. Ceci ne correspond cependant pas à la littérature médicale où la mortalité s'élève, en général, avec l'âge.[3,5-9]

Il est intéressant de noter que les patients qui n'avaient aucun antécédent de maladie ulcéreuse ont eu un taux de mortalité statistiquement plus élevé que ceux qui avaient un passé ulcéreux connu. Cette constatation confirme en partie les travaux de Byrne, Guardione et Williams[5] qui ont montré un taux de mortalité plus élevé à l'occasion de la première hémorragie, comparée à une deuxième, une troisième ou à de multiples hémorragies.

La mortalité chez nos patients ayant un diagnostic d'ulcère duodénal est inférieure à la mortalité par ulcère gastrique ou par gastrite aiguë. Cependant, nos résultats ne sont pas statistiquement différents. A la clinique Mayo, où on a étudié la mortalité de 61 patients porteurs d'ulcère duodénal opéré d'urgence, la mortalité a été à 11.5%, soit 7 patients décédés.[10] Crook et ses collaborateurs[3] ont observé une mortalité de 14% pour les ulcères duodénaux opérés d'urgence et de 26% pour les ulcères gastriques. Foster, Hickok et Dunphy[9] ont eu des pourcentages de 20% et 26% respectivement. Yajko, Norton et Eiseman[2] ont rapporté une mortalité de 42% pour les gastrites alcooliques et Crook et ses collaborateurs,[3] de 49%.

L'opération idéale dans les cas d'urgence n'a pas encore été établie scientifiquement avec certitude. La gastrotomie avec ligature de l'ulcère est à rejeter à cause de son taux de récidive hémorragique trop élevé. La vagotomie avec pyloroplastie est très populaire, surtout depuis que Foster, Hickok et Dunphy[9] ont démontré qu'ils avaient réussi à diminuer le taux de mortalité de moitié après être passés de la résection gastrique à la vagotomie et pyloroplastie. L'objection principale à la résection gastrique est le taux de mortalité qui serait plus élevé. Byrne, Guardione et Williams,[5] Wilkinson,[6] Buckingham et Remine[10] et nous-mêmes[11] n'avons pu démontrer une différence de mortalité entre ces deux modes d'opération. Il est très difficile de juger de la supériorité de la valeur d'une opération comparée à l'autre parce que beaucoup de chirurgiens emploient la vagotomie avec pyloroplastie chez des patients moribonds et jugés trop âgés pour subir une résection. L'objection principale à la vagotomie et pyloroplastie est le taux de récidive hémorragique qui, dans notre série, est plus élevé que pour la vagotomie avec résection. Il est à noter que dans notre série, comme dans celle de Yajko, Norton et Eiseman,[2] qu'aucun patient qui a subi une vagotomie avec résection n'a eu de récidive.

L'étude des causes de décès montre que le manque d'agressivité du chirurgien, ou encore son espoir de voir la nature juguler d'elle-même l'hémorragie, sont responsables, en grande partie, d'un taux de mortalité aussi élevé. Nos patients ont été opérés en moyenne près de 100 heures après leur hospitalisation, et après qu'on leur eut infusé, en moyenne, 11 unités de sang.

Read, Huebl et Thal,[12] dans une étude randomisée, ont comparé le traitement chirurgical immédiat au traitement chirurgical retardé. Trente-trois patients porteurs d'ulcère gastrique ou duodénal ont été opérés, en moyenne, 5 heures après leur hospitalisation, et après avoir reçu une moyenne de huit unités de sang (4.5 en préopératoire): il n'y a eu aucun décès dans ce groupe. Le groupe comparé comportait 20 sujets opérés, en moyenne, 32 heures après leur hospitalisation et après avoir reçu une moyenne de 15 unités de sang (9 en préopératoire): la mortalité de ce groupe s'est élevée à 30% (6 décès). Si l'on se base sur ces critères, nos patients faisaient partie de ce dernier groupe et ont présenté le même taux de mortalité.

Chez une série de 456 patients traités pour hémorragie, Palmer[13] a démontré que la mortalité augmentait de façon significative avec le nombre de transfusions; les sujets qui avaient reçu moins de 6 unités du sang ont eu un taux de mortalité inférieur à 4%, ceux qui ont reçu entre 7 et 9 unités, ont vu ce taux augmenter à 16% et ceux qui ont reçu plus de 10 unités ont atteint un taux de mortalité de 26%. Thorne et Nyhus[14] ont présenté des chiffres encore plus dramatiques: 30 de leurs patients ont reçu plus de 10 unités, et le taux de mortalité a été de 70%.

Conclusion

La chirurgie d'urgence de l'hémorragie par maladie ulcéreuse ou par gastrite aiguë est grevée d'un taux de mortalité très élevé, soit près de 30%. L'âge des patients semble être un facteur important selon la littérature médicale consultée, quoique ceci ne se soit pas réfleté dans notre série. Le premier épisode hémorragique montre un taux de mortalité plus élevé que les épisodes ultérieurs. La localisation de l'ulcère est importante, les ulcères duodénaux ont un meilleur pronostic vital que les ulcères gastriques. Les gastrites aiguës hémorragiques qui ne se tarissent pas spontanément ont également un taux de mortalité très élevé.

Le genre d'intervention dans notre série ne semble pas jouer un rôle important quant à la mortalité, mais il a influencé cependant la récidive hémorragique. Pour cette dernière raison, nous rejetons la gastrotomie simple avec ligature de l'ulcère et nous préférons la vagotomie et résection à la vagotomie et pyloroplastie. Enfin, le facteur le plus important pour diminuer le taux de mortalité consiste à poser un diagnostic précoce par une endoscopie de type agressif, et de procéder à l'intervention chirurgicale dans les plus brefs délais, tout en procédant à une réanimation rapide et agressive.

Bibliographie

1. SANDLOW LJ, BECKER GH, SPELLBERG MA, et al: A prospective randomized study of the management of upper gastrointestinal hemorrhage. *Am J Gastroenterol* 61: 282, 1974
2. YAJKO RD, NORTON LW, EISEMAN B: Current management of upper gastrointestinal bleeding. *Ann Surg* 181: 474, 1975
3. CROOK JN, GRAY LW JR, NANCE FC, et al: Upper gastrointestinal bleeding. *Ann Surg* 175: 771, 1972
4. CLERMONT R: Hémorragie digestive haute: approche conventionnelle ou agressive? Etude comparative. Présenté au congrès régional du Collège royal des médecins et chirurgiens du Canada, Québec, octobre 1972
5. BYRNE JJ, GUARDIONE VA, WILLIAMS LF: Massive gastrointestinal hemorrhage. *Am J Surg* 120: 312, 1970
6. WILKINSON RH: Management of acute upper gastrointestinal hemorrhage. *Can J Surg* 16: 72, 1973
7. CAMMOCK EE, HALLETT WY, NYHUS LM, et al: Diagnosis and therapy in gastrointestinal hemorrhage. A study of 410 patients. *Arch Surg* 86: 608, 1963
8. ENQUIST IF, KARLSON KE, DENNIS C, et al: Statistically valid ten-year comparative evaluation of three methods of management of massive gastroduodenal hemorrhage. *Ann Surg* 162: 550, 1965
9. FOSTER JH, HICKOK DF, DUNPHY JE: Changing concepts in the surgical treatment of massive gastroduodenal hemorrhage. *Ann Surg* 161: 968, 1965

10. BUCKINGHAM JM, REMINE WH: Results of emergency surgical management of hemorrhagic duodenal ulcer. *Mayo Clin Proc* 50: 223, 1975
11. KHOURY S, ALAM J, RHEAULT MJ: Les complications per et postopératoires précoces de la vagotomie. *Union Med Can* 101: 2432, 1972
12. READ RC, HUEBL HC, THAL AP: Randomized study of massive bleeding from peptic ulceration. *Ann Surg* 162: 561, 1965
13. PALMER ED: Upper gastrointestinal hemorrhage. *JAMA* 231: 853, 1975
14. THORNE FL, NYHUS LM: Treatment of massive upper gastrointestinal hemorrhage: a ten-year review. *Am Surg* 31: 413, 1965

The Gastroplasty Tube as a Method of Reflux Control

R.D. HENDERSON, MB, FRCS[C]

Follow-up of 135 patients who underwent Belsey gastroplasty because of intractable reflux demonstrated that 44% had continued reflux and 25% had symptoms of reflux that were serious, despite a very low rate of anatomic recurrence. Most of the patients with symptomatic reflux had major preexisting esophageal pathologic conditions related to previous surgery, esophageal ulceration, stricture, or scleroderma. In this group Belsey gastroplasty was not an effective method of reflux control.

Total fundoplication gastroplasty (TFG) in 100 consecutive patients has so far had the same low rate of anatomic recurrence, most likely related to the gastroplasty tube; however, longer follow-up is necessary to confirm this fact. TFG is effective in controlling reflux; none of the 100 patients so treated had clinical or radiologic evidence of reflux on follow-up examination.

Le suivi de 135 patients qui ont subit une gastroplastie de Belsey pour reflux gastrique résistant, a démontré que 44% avaient une persistance du reflux et que 25% souffraient de sérieux symptômes de reflux en dépit d'un très faible taux de récidive anatomique. La plupart des patients présentant des symptômes de reflux souffraient déjà de pathologie oesophagienne importante résultant de chirurgie antérieure, d'ulcération oesophagienne, de stricture ou de sclérodermie majeures. Parmi ce groupe, la gastroplastie de Belsey ne s'est pas avérée efficace pour contrôler le reflux gastrique.

La gastroplastie par plicature complète du fundus (GPF) effectuée chez 100 patients consécutifs a, jusqu'à maintenant, montré le même faible taux de récidive anatomique, probablement grâce au tube de gastroplastie; toutefois, ce fait devra être confirmé par un suivi plus prolongé. La GFP est efficace pour contrôler le reflux gastrique; aucun des 100 patients traités de cette façon n'a montré de signes cliniques ou radiologiques de reflux aux examens de post-cure.

From the department of surgery, University of Toronto, Toronto, Ont.

Presented at the annual meeting of the Royal College of Physicians and Surgeons of Canada, Toronto, Jan. 27, 1977

Reprint requests to: Dr. R.D. Henderson, Department of surgery, Women's College Hospital, Toronto, Ont. M5S 1B2

The fact that many different operations have been developed to control gastroesophageal reflux indicates that no single operation has achieved total success. The ability to produce effective reflux control and avoid anatomic recurrence of the hiatal hernia are the two major factors to be considered in assessing the results of surgery.

From evaluation of the results of the Nissen,[1] Hill[2] and Belsey[3] hernia repairs, the Nissen[4] total fundoplication appears to be the most successful method of preventing reflux. Despite its effectiveness, this operation and other standard repairs all result in a high rate of anatomic recurrence. The standard repair of Belsey, which is the one most often studied, has a recurrence rate of 11.5% at 10 years.[5]

When the esophagus is shortened by panmural esophagitis or scarring,[5] the hernia cannot be reduced by surgical means. Attempted repair by standard methods results in an even higher rate of anatomic recurrence.[6] Collis[7] developed his gastroplasty tube for the management of patients with gastroesophageal reflux. With this method, a tube is cut from the lesser curve of the stomach, in continuity with the esophagus, and the hernia fundoplication is created around the gastroplasty tube. Pearson[8,9] modified this operation by using a Belsey fundoplication rather than the Collis procedure to fix the gastroplasty tube below the diaphragm. This operation is commonly referred to as a Belsey gastroplasty, but a better term is partial fundoplication gastroplasty.

In my experience, the Belsey gastroplasty has effectively reduced the frequency of anatomic recurrence of the hernia to a very low level; nevertheless, continued reflux is a major problem.[10] For this reason, a modified Nissen fundoplication has been added to the use of the gastroplasty tube, in an attempt to reduce both anatomic recurrence and reflux to a more acceptable level. This operative procedure is referred to as a total fundoplication gastroplasty (TFG).

Patients and Methods

Belsey gastroplasty was performed on 135 patients with medically intractable gastroesophageal reflux. Follow-up ranged from 2.5 to 7.5 years (average, 3.2 years).

In addition to having a detailed history taken, all patients were evaluated by radiology, manometry and endoscopy before surgical correction. Esophageal manometry was performed with PE 190 catheters with side openings located 2.5 and 5 cm apart. Constant water infusion was maintained at 6.8 mL/min per tube with a modified

Harvard pump. Statham P23De strain gauges were used as sensing devices and data were recorded on a 1508 Honeywell ultraviolet Visicorder (Honeywell, Denver, CO).

Of the 135 patients, 127 were seen at follow-up, 5 were contacted by letter or reports were received from the family practitioner, 2 were lost to follow-up and 1 died at operation. In 115 patients radiologic studies were undertaken to determine the presence of recurrence or reflux and in 39 follow-up esophageal manometry was performed.

Of those treated by Belsey gastroplasty, 32 had undergone previous hernia repair and 35 previous gastric surgery, 27 had a peptic stricture, 7 had scleroderma, 3 had had previous esophageal myotomy and 28 had an uncomplicated hiatal hernia.

One hundred consecutive patients were treated by TFG because medical management had failed; 23 had a recurrent hiatal hernia, 10 had had previous gastric surgery, 3 had a peptic stricture, 2 had scleroderma, 3 had had a previous myotomy and 59 had an uncomplicated hiatal hernia. One patient could not be evaluated preoperatively by manometry because of a very tight stricture, which made the measurements obtained inaccurate. Follow-up was from 6 months to 2½ years (average 15 months).

The technique of preparing a gastroplasty tube is similar for both the Belsey[8] and total fundoplication[10] procedures. A transthoracic or thoracoabdominal incision is used and the esophagus is mobilized to the aortic arch. The tube is cut over a Maloney bougie and the incision in the tube and fundus closed with continuous 2-0 chromic catgut and 3-0 silk sutures in two layers. Posterior crural sutures of 1-0 silk are placed ready to be tied following fundoplication (Fig. 1).

The Belsey fundoplication was created with four layers of transverse sutures, fixing the fundus of the stomach to the gastroplasty tube and distal esophagus and covering 240° of their circumference. Fixation to the diaphragm was by suturing the fundus directly to its under-surface (Fig. 2).

TFG is created by sewing fundus to gastroplasty tube and, where possible, the distal 2 cm of esophagus with a single layer of interrupted mattress sutures of 2-0 silk. Following fixation the fundus is then wrapped circumferentially and complete fundoplication effected over a length of 3.5 cm with interrupted mattress sutures of 2-0 silk. In TFG the following measurements are strictly followed: gastroplasty tube, 5 cm; lower esophageal suturing, 2 cm; complete fundoplication, 3.5 cm (Fig. 3). Where severe disordered motor activity (DMA) or scleroderma is present or a previous myotomy has been performed, the length of total fundoplication is reduced to 2 cm to avoid overcompetence and dysphagia. To confirm that the repair is not too tight, on completion of the fundoplication it should be possible to admit a finger easily between the wrap and the gastroplasty tube.

In 11 patients a previous Belsey gastroplasty was converted to a TFG because of failure to control reflux, severe residual symptoms of reflux and a poor response to vigorous conservative management. Eight of these patients were followed up for 6 months or more and are included in the present study. In each patient a short thoracoabdominal incision was used and the gastroplasty flap taken down without further mobilization. The gastroplasty tube was measured and calibrated with a no. 60 French bougie before conversion to a TFG. Follow-up ranged from 6 to 13 months (average, 10.8 months).

Results

Each patient was assessed and the results were categorized as follows: stage 1a, patients were totally asymptomatic with no radiologic evidence of reflux; stage 1b, patients had minor nonspecific symptoms but were generally well with no clinical or radiologic evidence of reflux; stage 2, patients had radiologic evidence of reflux and mild symptoms; stage 3a, patients had severe symptoms and radiologic evidence of reflux; stage 3b, patients had anatomic recurrence.

With Belsey gastroplasty, stage 1a results were achieved in 28.7% of patients; stage 1b in 25% and stage 2 in 18.9%. The most important finding was the high incidence of substantial radiologic and symptomatic reflux, which occurred in 25.7% of patients.

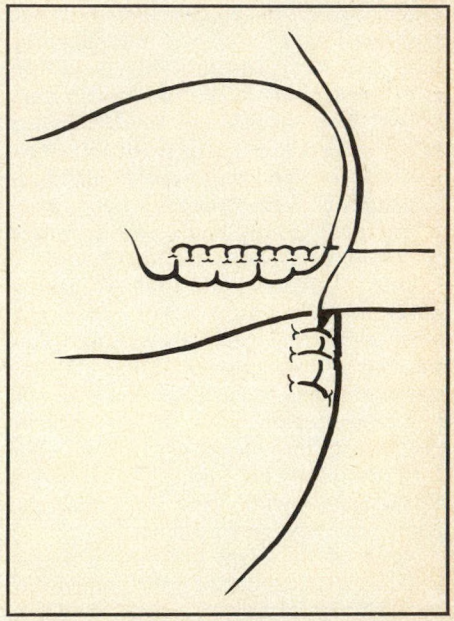


FIG. 2—Belsey wrap. Modified Belsey fundoplication is used for fixation of gastroplasty tube. Newly created fundus of stomach is sutured to tube and lower esophagus to give 240° wrap. This is then reduced below diaphragm and crurae are closed with interrupted silk sutures.

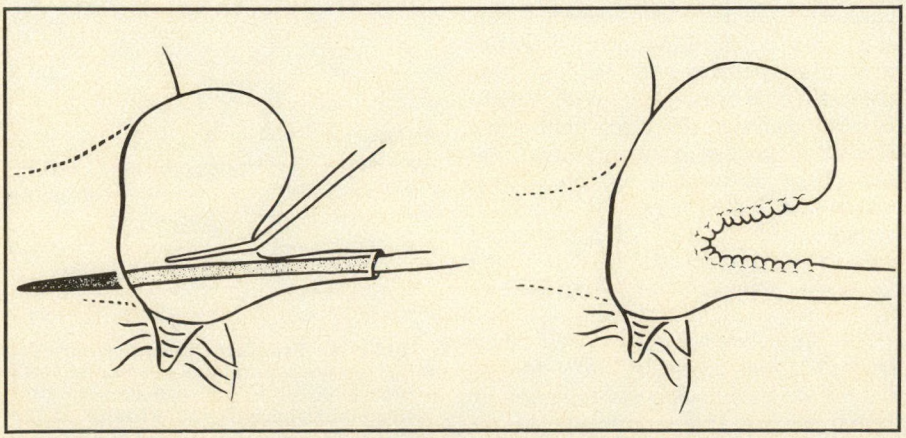


FIG. 1—Technique for preparing gastroplasty tube. Tube is same for Belsey and total fundoplication gastroplasty (TFG). It is cut from lesser curve of stomach over Maloney bougie. Sutured tube is then fixed below diaphragm by fundoplication.

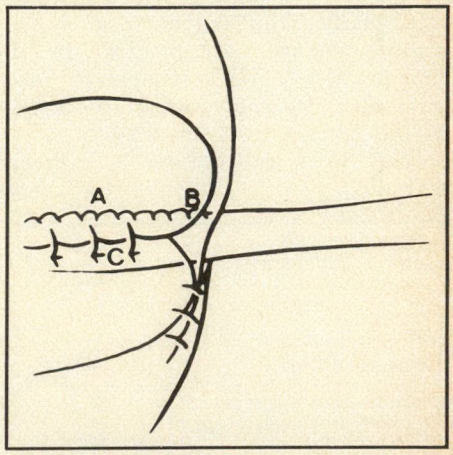


FIG. 3—Nissen wrap. TFG is completed by wrapping 5-cm gastroplasty tube (A) and distal 2 cm of esophagus (B) with newly created gastric fundus. Total fundoplication is complete over 3.5 cm (C).

Anatomic recurrence was present in 1.5% of patients.

Correlation between the results of Belsey gastroplasty and the presence or absence of pre-existing major esophageal or gastric pathologic changes showed a much higher incidence of continuing radiologic and symptomatic reflux when gastroplasty was performed after previous gastric or esophageal surgery or esophageal myotomy, or in the presence of peptic stricture or scleroderma (Table I).

In patients with a TFG, stage 1a results were achieved in 61% of patients and stage 1b in 38%. No patient had radiologic or symptomatic reflux and 1% had anatomic recurrence (stage 3b).

Two patients with a TFG had continued severe dysphagia and required modification of their fundoplication. Both had very severe DMA and this was considered to be a contributory factor. The length of fundoplication was reduced to 2 cm with effective relief of symptoms. In both instances the patients were operated upon early in the study; now such problems can be anticipated and avoided.

Two patients with Belsey gastroplasty and one with a TFG had anatomic recurrence and all required further surgery to control reflux. Of the two with Belsey gastroplasty one had a repeat repair with Belsey gastroplasty and the other with TFG. The third patient who had a TFG had a repeat repair with TFG. All these patients are now asymptomatic.

None of the eight patients in whom a Belsey gastroplasty was converted to a Nissen gastroplasty had evidence of reflux on clinical and radiologic evaluation.

Results of Manometry

Esophageal manometry was performed in 39 patients with a Belsey gastroplasty 3 to 36 months after operation (average, 11.8 months). In 51 patients with a TFG, manometry was performed 3 to 12 months postoperatively (average, 5.2 months).

With Belsey gastroplasty the average tone of the high pressure zone (HPZ) decreased by –2.4 cm H_2O and with TFG the tone of the HPZ increased by +4.2 cm H_2O following operation.

DMA in the distal half of the esophagus decreased by –2.4% with Belsey gastroplasty and by –18% with TFG.

The excess of pressure in the gastroplasty tube over that in the gastric fundus, recorded during manometric study, averaged 1.4 cm H_2O after Belsey gastroplasty and 1.7 cm H_2O after TFG.

Table I—Belsey Gastroplasty. Incidence of Symptomatic Reflux in relation to Previous Esophageal Disease

Esophageal disease	Incidence, %
Previous gastric surgery	32
Previous esophageal surgery	28
Peptic stricture	21
Scleroderma	45
Previous myotomy	100
Uncomplicated hernias	3
Total incidence	25.7

Discussion

The reported results of Belsey gastroplasty vary widely. Pearson reported follow-up of 163 patients of whom 11 (6.8%) had symptomatic reflux; reflux was demonstrated radiologically in 18 (13.6%) of 132 patients, but no manometric data were recorded.[10] Orringer reported on 83 patients operated on since 1974 with follow-up available on 76 (average follow-up of less than 1 year); 21 (27.7%) had moderate to severe reflux and 12 (15.7%) had symptoms of reflux.[10] In our study the total incidence of radiologic reflux was 44% and of symptomatic reflux 25.7%, with a much longer follow-up.

In all three studies the frequency of radiologic recurrence of the hernia was much below that recorded for standard hiatal hernia repair.

An explanation for the difference in results is not readily forthcoming but must lie in the methods used in follow-up evaluation, in some aspect of operative technique, or in the extent of pre-existing esophageal pathology.

Three aspects of operative technique that may vary are the methods of suture fixation, the length and diameter of the gastroplasty tube and the extent of circumferential wrap involved in the Belsey fundoplication. Suture fixation is unlikely to be important since the rate of anatomic recurrence is low. Variations in tubal length and diameter have been considered a possible source of difference; however, in all three studies a 5- to 6-cm gastroplasty tube was used. With regard to tubal diameter, Orringer used a no. 60 French bougie to cut his tubal segment, Pearson used a no. 50 French bougie and I used a no. 46 or no. 50 French bougie in 85% of patients and a no. 56 or no. 60 in 15%.[10] I found the results were unaffected by the size of tube used.

All three authors described their fundoplications as being 240°, following the original technique reported by Belsey so that this is unlikely to account for differences in results. Pre-existing pathologic change is of major importance and the rate of reflux increases sharply in patients who have had previous surgery or who have disorders producing motor damage (Table I). This factor may be the key to the differences in reported results.

Control of Reflux following Gastroplasty

TFG effectively controlled reflux regardless of the preoperative condition. The gastroplasty with Belsey repair, while effective in those with uncomplicated hernias, was ineffective when the esophagus had been damaged by previous surgery or disease. To explain this the various properties of the gastroplasty tube, the HPZ and the fundoplication were examined to determine differences in the operative technique that might explain the clinical results.

In the normal subject (Fig. 4) the distal HPZ and the intra-abdominal segment of esophagus are important in the control of reflux.[11] For effective control, the sphincter must be able to resist reflux (intragastric) pressures in the stomach. Increases in intraperitoneal pressure may occur with postural change or with lifting. Selective increases in intragastric pressure not associated with increased peritoneal pressure may occur with eating or gastric contraction. Increased intraperitoneal pressure acts on both stomach and intra-abdominal esophagus. These pressures counterbalance each other and the sphincter continues to exert a pressure barrier preventing reflux. When gastric pressure is selectively increased, the sphincter increases its tone through neurogenic and hormonal reflexes, and again reflux is prevented.

Gastroplasty tubes provide an intra-abdominal segment of tubed stomach. In the present study, pressure measurements in the gastroplasty tubes were very low (1.4 cm H_2O after Belsey gastroplasty and 1.7 cm H_2O after

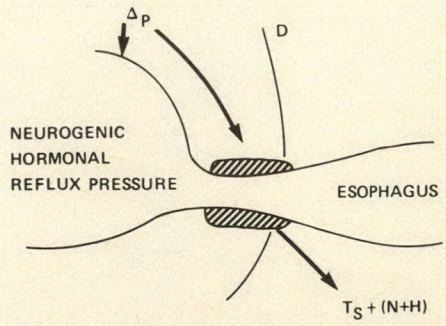


FIG. 4—Pressure barrier controlling reflux in normal subject. Increased intraperitoneal pressure (△P) acts on both intra-abdominal esophagus and stomach so that reflux does not occur. Increases in gastric pressure are counterbalanced by sphincteric tone (Ts) plus neurogenic (N) and hormonal (H) reflexes.

TFG). One paper does describe high pressures in gastroplasty tubes studied soon after operation; however, these measurements were on eight patients studied at 1 week to 3 months[12] and were contrary to those found in long-term studies of 90 patients in the present report and in 76 patients studied by Orringer.[10] If the pressure measurements in the gastroplasty tube are considered to be low, then this tube acts passively and, while it may prevent reflux due to increases in intraperitoneal pressure (Fig. 5), it cannot resist reflux from selective increases in gastric pressure. The effectiveness of the HPZ in this situation is critical to reflux control. If the HPZ is intra-abdominal and capable of responding to neurogenic and hormonal influences, reflux will be prevented. If the sphincter has been damaged by previous surgery or disease, it may be unresponsive and reflux will then occur.

The type of fundoplication then becomes critical in reflux control. The Belsey fundoplication is a 240° wrap of gastroplasty and sphincter (Fig. 6). Selective increases in gastric pressure can be transmitted to the gastroplasty tube and sphincter by the fundoplication; however, this pressure transmission will be incomplete, as 120° of the circumference is not wrapped with stomach.

With the TFG, fundoplication is 360° (Fig. 7) and will transmit intragastric pressure to the gastroplasty tube. Because of this, the TFG effectively provides resistance to both passive increases in peritoneal pressure and selective increases in gastric pressure.

These theoretical considerations have not been proved; however, they explain why Belsey gastroplasty is successful in patients with uncomplicated hernias yet does not control reflux in those with major pre-existing pathologic conditions.

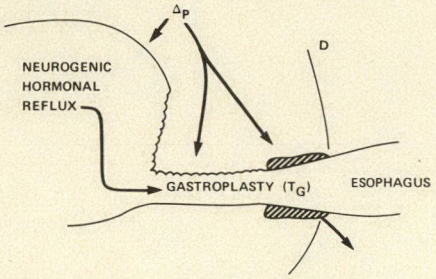


FIG. 5—Gastroplasty tube. When gastroplasty tube is used intraperitoneal pressure increases (△P) act both on stomach and tube and are counterbalanced to prevent reflux. Selective pressure increases in stomach are counterbalanced by tubal tone plus sphincteric pressure (T_G). Neurogenic and hormonal reflexes may not be active owing to previous disease or injury, and reflux may occur.

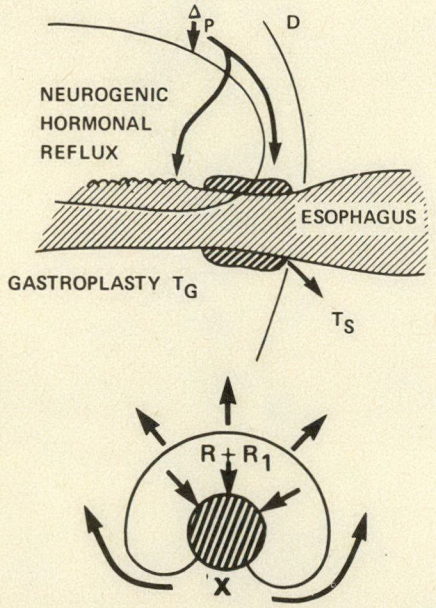


FIG. 6—Belsey gastroplasty. With Belsey gastroplasty, 240° wrap helps in transmission of gastric pressure to gastroplasty (R_1); however, bare area of tube (X) prevents total transmission of gastric pressure and this may result in reflux.

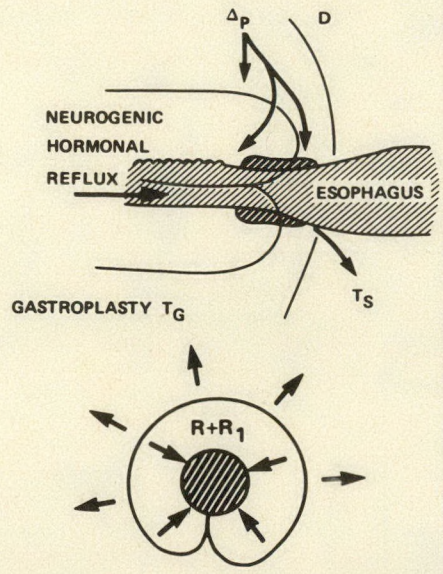


FIG. 7—Nissen gastroplasty. With TFG, 360° wrap of stomach to tube and sphincter allows total transmission of intragastric pressure and prevents reflux when gastric pressure is selectively increased.

References

1. WOODWARD ER, RAYL JE, CLARKE JM: Esophageal hiatus hernia. *Curr Probl Surg* 1, Dec. 1970
2. HILL LD: An effective operation for hiatal hernia: an eight year appraisal. *Ann Surg* 166: 681, 1967
3. HILL LD, TOBIAS J, MORGAN EH: Newer concepts of the pathophysiology of hiatal hernia and esophagitis. *Am J Surg* 111: 70, 1966
4. DEMEESTER TR, JOHNSON LF, KENT AH: Evaluation of current operations for the prevention of gastroesophageal reflux. *Ann Surg* 180: 511, 1974
5. BRAIN RH, MAYNARD J: Fascia lata graft repair of esophageal hiatal hernia. *Am J Surg* 115: 488, 1968
6. HENDERSON RD, PEARSON FG: Preoperative assessment of esophageal pathology. *J Thorac Cardiovasc Surg* 72: 512, 1976
7. COLLIS JL: Gastroplasty. *Thorax* 16: 197, 1961
8. PEARSON FG, HENDERSON RD: Experimental and clinical studies of gastroplasty in the management of acquired short esophagus. *Surg Gynecol Obstet* 136: 737, 1973
9. PEARSON FG, LANGER B, HENDERSON RD: Gastroplasty and Belsey hiatus hernia repair. An operation for the management of peptic stricture with acquired short esophagus. *J Thorac Cardiovasc Surg* 61: 50, 1971
10. HENDERSON RD: Reflux control following gastroplasty. *Ann Thorac Surg* 24: 206, 1977
11. HENDERSON RD, GODDEN JO: *Motor Disorders of the Esophagus,* Baltimore, Williams & Wilkins, 1976
12. COOPER JD, GILL S, NELEMS JM, et al: Intraoperative and postoperative esophageal manometric findings with Collis gastroplasty and Belsey hiatus hernia repair for gastroesophageal reflux (to be published)

BOOKS RECEIVED

continued from page 256

Nutritional Aspects of Care in the Critically Ill. Edited by J.R. Richards and J.M. Kinney. 668 pp. Illust. Churchill Livingstone, Edinburgh; Longman Canada Limited, Don Mills, 1977. $38.40. ISBN 0-443-01578-3.

Pediatric and Adult Reconstructive Urologic Surgery. Edited by John A. Libertino and Leonard Zinman. 320 pp. Illust. The Williams & Wilkins Company, Baltimore; Burns & MacEachern Limited, Don Mills, 1977. $46. ISBN 0-683-04978-X.

Précis de Chirurgie Infantile. Diagnostic, Indications et Principes Thérapeutiques. Marcel Bettex, François Kuffer et Aloïs Schärli. 372 pp. Illust. Masson, Paris, 1978. $68.75, broché. ISBN 2-225-48521-6.

Pye's Surgical Handicraft. 20th ed. Edited by James Kyle. 744 pp. Illust. John Wright & Sons Ltd., Bristol; Year Book Medical Publishers, Inc., Chicago, 1977. $7.25, paperbound. ISBN 0-8151-5239-6.

Recent Advances in Intensive Therapy. Number One. Edited by I. McA. Ledingham. 257 pp. Illust. Churchill Livingstone, Edinburgh; Longman Canada Limited, Don Mills, 1977. $32. ISBN 0-443-01432-9.

Reconstructive Microsurgery. Rollin K. Daniel and Julia K. Terzis. 491 pp. Illust. Little, Brown & Company (Inc.), Boston, 1977. $48.50. ISBN 0-316-17255-3.

continued on page 271

metamucil®

Comfortable relief. Naturally.

FOR POST-OPERATIVE PATIENTS

Many post-operative patients require a laxative to encourage relief from constipation. Trust Metamucil to provide just that for some very good reasons:

- Metamucil is made from grain, not chemical stimulants, oils or salines to provide soft, fully formed stools
- Metamucil promotes regular bowel function, physiologically, without straining, cramping or irritation
- Metamucil will not cause laxative dependency or loss of bowel tone
- Metamucil provides the bulk lacking in many diets

Available as Metamucil powder, low in sodium for your geriatric and cardiac patients; and lemon-lime flavoured Metamucil Instant Mix, low in calories for diabetics or those patients whose carbohydrate intake is restricted.

The dosage can be individually regulated.

For short or long term treatment and successful bowel management, trust Metamucil for all kinds of patients.

The laxative most recommended by physicians.

SEARLE Searle Pharmaceuticals
Oakville, Ontario
L6H 1M5

Critique of Items 456-458 (SESAP II)

456—For item 456, response (A) is correct. During the 40 years of its course to date, the epidemic of carcinoma of the lung has caused almost a million deaths in the United States alone, and another million can be almost certainly predicted before the epidemic subsides. The predominance of males among lung cancer patients, as well as the remarkable increase in rates observed in the countries of western Europe beginning about 1920, suggests that cigarette smoking might be responsible. Several dozen studies have subsequently shown that the risk of developing lung cancer increases regularly in proportion to the number of cigarettes an individual smokes. Smokers of two or more packs of cigarettes per day have about 20 times the risk of nonsmokers. About 10 per cent of smokers of two or more packs per day can be expected to develop lung cancer. Smokers of cigars and pipes have lung cancer risks that are definitely higher than those of nonsmokers. It is estimated that over 90 per cent of the present incidence of lung cancer in this country could be prevented by eliminating the effect of cigarette smoking.

A

457—For item 457, response (B) is correct. The overall incidence of cancer of the colon and rectum has remained about the same during the past 30 to 40 years, as is shown on the graph. It was predicted that cancer of the colon and rectum would afflict about 75,000 new patients every year and cause 46,000 deaths per year. This makes the colon and rectum the leading site of cancer in both males and females in North America (exclusive of skin cancers which are rarely associated with any mortality) and, after lung cancer, the second most fatal carcinoma. The high incidence of cancer of the large bowel among persons living in the United States, Canada, and western Europe, compared to Japan, Africa, and other eastern countries, has aroused much speculation regarding etiology. The fact that the death rate among Japanese migrating from Japan to the United States rises and approaches the mortality in the United States has led some epidemiologists to conclude that the cause of cancer of the large bowel is not racial or genetic, but environmental. It has been known for decades that degradation products of bile salts are carcinogenic to animals. Burkitt (1971) has postulated that, since the inhabitants of the United States eat a diet high in refined carbohydrates (with low residue), any carcinogen in the bowel lumen would consequently be present in much higher concentration, particularly if there is bowel stasis, which appears to be prevalent in the United States.

B

458—For item 458, response (C) is correct. One of the most fascinating aspects of malignant disease, as outlined on the graph, is the marked reduction in the incidence of carcinoma of the stomach in the United States during the past 40 years. From 1935 to 1939, there were 17 men with cancer of the stomach for every 10 men with cancer of the colon. Colonic cancer did not change markedly over the next 30 years as carcinoma of the stomach declined, so that by 1960 to 1964 there were only 6 men with stomach cancer for every 10 with colonic cancer. The cause of this dramatic decline in carcinoma of the stomach has provoked a great deal of speculation but remains an enigma.

C

References

456-458/1. Longmire WP Jr: Carcinoma of the stomach, in Sabiston DC Jr (ed): (Davis-Christopher) Textbook of Surgery, ed 10. Philadelphia, WB Saunders Co, 1972, pp 860-861

456-458/2. Cohn I Jr, Nance FC: The colon and rectum, in Sabiston DC Jr (ed): (Davis-Christopher) Textbook of Surgery, ed 10. Philadelphia, WB Saunders Co, 1972, p 965

456-458/3. Cole WH: Cancer of the colon and rectum. Surg Clin North Am 52:871-881, 1972

456-458/4. Statistics on cancer. CA 17:34-43, 1967

456-458/5. Silverberg E, Grant RN: Cancer statistics, 1970. CA 20:11-23, 1970

456-458/6. Silverberg E, Holleb AI: Cancer statistics, 1974—Worldwide epidemiology. CA 24:2-21, 1974

456-458/7. Burkitt DP: Epidemiology of cancer of the colon and rectum. Cancer 28:3-13, 1971

Lipid Alterations in Acute Pancreatitis

E.J. LAZARO, MD, FRCS[C], FACS,* A.K. BOSE, SC D,† R. SPRAGGINS, PH D† AND B.R. DISPENZIERE, BS*

The authors studied the lipid profile in acute pancreatitis in humans and also in dogs in which this disease had been induced experimentally. Blood samples were analysed by mass spectroscopy and gas chromatography. During the acute phase of the pancreatitis there was a significant reversal of the ratio of unsaturated fatty acids. There was a marked increase in the concentration of fatty acids in the blood with monounsaturation in both carbon-16 and carbon-18 chains and diunsaturation in the later carbon chains. These changes have not been reported in any disease state.

Les auteurs ont étudié le bilan lipidique dans la pancréatite aiguë chez des humains ainsi que chez des chiens dont cette maladie avait été provoquée expérimentalement. Les échantillons de sang ont été étudiés par spectroscopie de masse et par chromatographie gazeuse. Durant la phase aiguë de la pancréatite une inversion significative du rapport des acides gras insaturés a été observée. Il y a eu une augmentation marquée de la concentration des acides gras du sang avec monoinsaturation sur les chaînes à 16 et 18 carbones et bisinsaturation sur les chaînes plus longues. De tels changements n'ont pas été signalés dans aucune maladie.

Lipid abnormalities that are known to occur in acute pancreatitis include the presence of lactescent serum, hypertriglyceridemia, decreased postheparin lipolytic activity and abnormal lipoprotein electrophoretic patterns.[1] In this communication we describe important and hitherto unreported changes in carbon-16 and carbon-18 fatty acids of the blood in acute pancreatitis induced experimentally in dogs and also in acute pancreatitis in humans.

Materials and Methods

Acute pancreatitis was produced in seven dogs (experimental group) by use of the Pfeffer closed duodenal loop preparation. In 18 dogs (control group) various conditions that clinically resemble acute pancreatitis and that may be associated with elevated amylase and lipase concentrations were created experimentally. These included celiotomy (in three dogs), bilateral ureteral ligation (in three), duodenal perforation (in three), strangulation obstruction (in four), strangulation obstruction with manipulation of the common bile duct (in three) and hemipancreatectomy (in two). Venous blood samples were obtained at 0 hours and 3, 6 and 9 hours after completion of each operative procedure. At the conclusion of each experiment the animal was killed with an overdose of pentobarbital sodium and an autopsy was performed.

Both mass spectroscopy and gas chromatography were used for analysis of blood samples. Mass spectroscopy interfaced with gas chromotography was particularly useful for analysis of the fatty acids as methyl esters. This method identified the variable we were concerned with in this study, that is, increased unsaturation of the fatty acids.

The fatty acid fractions were recovered by means of saponification with 1.0 N sodium hydroxide. The acids were converted to methyl esters with diazomethane and known weight solutions were analysed by gas chromatography and by the use of arachidic acid as an internal standard to obtain quantitative results.

The fatty acid profile was studied in three patients with acute pancreatitis and in five patients with nonpancreatic acute abdominal disease (controls).

Results

Histopathologic evidence of acute pancreatitis was present in all animals with the Pfeffer loop. Mild pancreatic inflammation occurred in animals with hemipancreatectomy and those with strangulation obstruction in which the common bile duct was also manipulated.

With our data from initial and final samples of the control dogs, and from initial samples of the dogs with pancreatitis, a baseline was established from which we observed the characteristic fatty acid changes. From gas chromatographic (GC) peak height measurements, control blood samples were found to contain carbon-16 unsaturated acids equivalent to about 15% of the saturated carbon-16 acid peak. In experimental pancreatitis this value has been observed to increase up to 20 times that amount (Table I). On the 6 SE (methyl silicone)-30 GC column used for this analysis, oleic and linoleic acids elute under a single

From the department of surgery, New Jersey Medical School, Newark, NJ and the department of chemistry and chemical engineering, Stevens Institute of Technology, Hoboken, NJ

Supported by National Institutes of Health grant ROI AM 17921

**Department of surgery, College of Medicine and Dentistry of New Jersey, New Jersey Medical School, Newark*

†*Department of chemistry and chemical engineering, Stevens Institute of Technology, Hoboken*

Reprint requests to: Dr. E.J. Lazaro, Professor of surgery, Department of surgery, College of Medicine and Dentistry of New Jersey, Martland Hospital, 65 Bergen St., Newark, NJ 97107, USA

Table I—Fatty Acid Changes in Surgically Induced Pancreatitis

Dog serial no.	U-16*	U-16 (subject) / U-16 (control)	U-18*	U-18 (subject) / U-18 (control)
1	1.07	4.0	4.16	3.0
6	2.80	23.0	7.14	5.5
7	1.31	15.0	4.76	5.0
9	0.43	1.6	1.79	1.4
29	1.40	7.8	6.25	3.0
35	0.86	4.3	3.70	2.0
36	0.37	1.9	3.23	1.7

*Relative degree of unsaturation is defined as peak height ratio in gas chromatographic peaks corresponding to unsaturated and saturated acids—that is, U-16 = peak (16:1) ÷ peak (16:0) and U-18 = peak (18:1 + 18:2) ÷ peak (18:0). 16:0 = palmitic (hexadecenoic) acid; 16:1 = palmitoleic (hexadecenoic) acid; 18:0 = stearic (octadecenoic) acid; 18:1 = oleic (octadecenoic) acid; and 18:2 = linoleic (octadecenoic) acid.

GC peak that is well separated from the peak for saturated stearic acid. Values of endogenous stearic acid, when compared with those of unsaturated carbon-18 fatty acids, varied from animal to animal. Changes in relative amounts of the unsaturated carbon-18 acids are therefore best compared with the amount of stearic acid for each individual analysis. It is difficult to predict normal stearic acid values either in the dog or in man. Table I also shows typical unsaturation changes in the carbon-18 fatty acids observed in dogs with experimentally induced acute pancreatitis.

Table II shows the changes observed by gas chromatography that occurred in experimental pancreatitis in the carbon-18 chain fatty acids clearly separated on an EGSP-Z* column. A and B represent two dogs with mild pancreatitis resulting from trauma to the pancreas during manipulation of the common bile duct. Here both the monounsaturated and diunsaturated fatty acids are clearly separated and were found to increase in concentration relative to stearic acid. Typical unsaturation changes in carbon-18 are noted, in contrast to the small to moderate changes in carbon-16 previously mentioned.

Varying degrees of the characteristic high concentrations of unsaturated fatty acids found in experimental pancreatitis were noted in the patients with acute pancreatitis and were not observed in control patients. As an example, the biochemical analyses of a 19-year-old woman with surgically proven acute pancreatitis are presented (Fig. 1). Blood samples were analysed at the height of the disease and at intervals as the clinical condition improved. Gas–liquid chromatographic determinations of the fatty acids in the plasma at the time the diagnosis was established at laparotomy are shown in tracing 1 of Fig. 1, while determinations during the recovery phase are noted in tracings 2 and 3. The elevated 16:1/16:0 ratio was gradually reduced to the normal value during recovery.

Table II—Typical Changes in Carbon-18 Fatty Acids in Surgically Induced Pancreatitis in Two Dogs

Acid	Composition, %* Initial	Final
Dog A		
Saturated	49	28
Monounsaturated	27	31
Diunsaturated	24	41
Dog B		
Saturated	47	25
Monounsaturated	25	30
Diunsaturated	28	45

*Values are expressed as percentage of total concentration of carbon-18 fatty acids.

*Ethylenesuccinate-phenyl silicone copolymer, supplied by Applied Science Laboratories Inc., State College, PA 16801.

Comment

From our findings the formation of unsaturated fatty acids in pancreatitis appears to be at the expense of saturated fatty acids. The extremely facile increase in concentration of fatty acids with monounsaturation in both carbon-16 and carbon-18 chains and with diunsaturation in the carbon-18 chains was completely unexpected and appears to be unreported for any disease. The amount of carbon-16 monounsaturated fatty acids in most biologic samples is about 15% of the amount of carbon-16 saturated fatty acids present.[2]

It is well known that all living systems are able to produce unsaturated acids from saturated precursors. Rapid changes in fatty acid composition can conceivably arise from selective mobilization of fatty acids from adipose tissue or from *de novo* synthesis of these acids. If the latter option is applicable in pancreatitis it would seem likely that the pancreas is capable of regulating in vivo dehydrogenase reactions in dogs and possibly in man.

Mammalian systems are known to be able to introduce unsaturation into fatty acids at different sites. Probable sites of dehydrogenation are at δ-2, -4, -5, -6 and -9. However, for the carbon-16 and carbon-18 fatty acids these possibilities are generally considered to be limited to the δ-2, -6 and -9 positions.

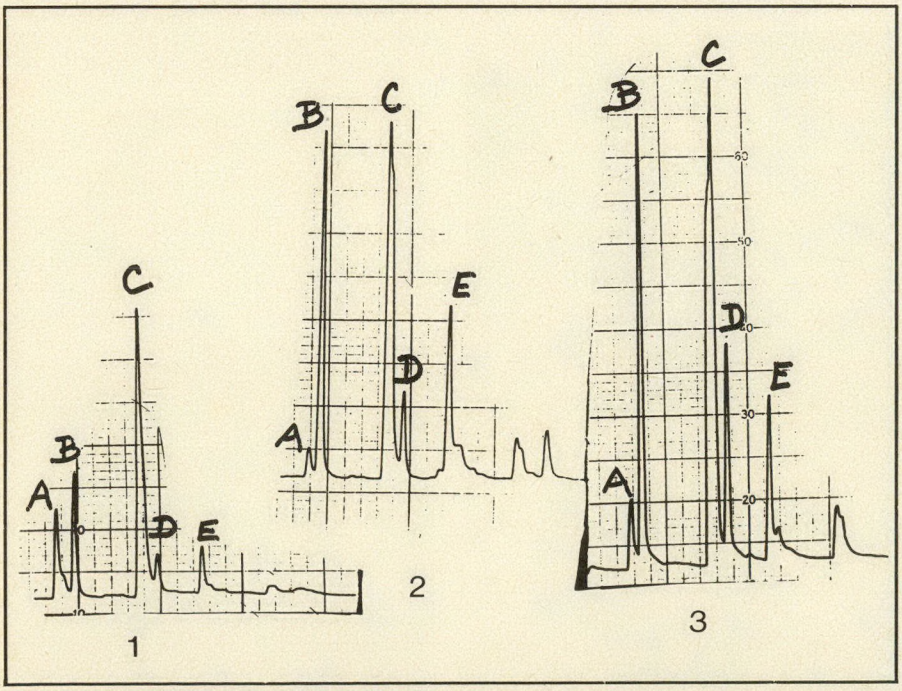


FIG. 1—Gas–liquid chromatographic tracings (X axis, time; Y axis, relative intensity of peak) in patient with acute pancreatitis (1) during phase of maximum clinical severity, (2) during phase of improvement and (3) upon recovery. (Compare ratios of peak areas C and D in each tracing.)

References

1. CAMERON JL, CAPUZZI DM, ZUIDEMA GD, et al: Acute pancreatitis with hyperlipemia: incidence of lipid abnormalities in acute pancreatitis. *Ann Surg* 177: 483, 1973
2. CAREN R, CORBO L: Plasma arachidonic acid and pancreas. *J Atheroscler Res* 4: 444, 1964

BOOKS RECEIVED

continued from page 267

Textbook of Surgery. 4th ed. Edited by David A. Macfarlane and Lewis P. Thomas. 787 pp. Illust. Churchill Livingstone, Edinburgh; Longman Canada Limited, Don Mills, 1977. $27.20, paperbound. ISBN 0-443-01607-0.

Trauma of the Chest. The Coventry Conference. Edited by W.G. Williams and R.E. Smith. 266 pp. Illust. John Wright & Sons Ltd., Bristol; Year Book Medical Publishers, Inc., Chicago, 1977. $23.10, paperbound. ISBN 0-7236-0484-3.

The Year Book of Orthopedics and Traumatic Surgery. 1977. Edited by Mark B. Coventry. 429 pp. Illust. Year Book Medical Publishers, Inc., Chicago, 1977. $25.25. ISBN 0-8151-1876-7.

The Year Book of Surgery. 1977. Edited by Seymour I. Schwartz, John S. Majarian, Erle E. Peacock, Jr., and others. 511 pp. Illust. Year Book Medical Publishers, Inc., Chicago, 1977. $20. ISBN 0-8151-7616-3.

The Year Book of Urology. 1977. Edited by John T. Grayhack. 392 pp. Illust. Year Book Medical Publishers, Inc., Chicago, 1977. Price not stated. ISBN 0-8151-3911-X.

Anévrisme athérosclérotique de l'artère sous-clavière

GILLES BEAUCHAMP, MD,* JEAN LASSONDE, MD, FRCS[C]† ET FERNAND LAURENDEAU, MD, FRCS[C]‡

Nous avons traité récemment un patient porteur d'une pathologie assez inusitée, soit un anévrisme de l'artère sous-clavière droite. La présence d'une masse pulsatile cervicale laisse soupçonner le diagnostic qui est confirmé par l'artériographie. L'approche chirurgicale utilisée consiste en une sternotomie partielle avec extension intercostale. L'anévrisme fut réséqué et la continuité vasculaire rétablie avec une prothèse synthétique.

An aneurysm of the right subclavian artery, a rare pathologic entity, is described. The presence of a pulsatile mass in the cervical region should always suggest the diagnosis, which is best confirmed by arteriography. Approaching the lesion by partial sternotomy extending to the third intercostal space gives excellent exposure. The aneurysm should be resected and vascular continuity re-established by the use of a synthetic prosthesis.

Les masses de la région cervicale posent souvent un problème de diagnostic, sauf lorsque la masse est pulsatile. Récemment, il nous a été adressé un patient présentant une masse pulsatile à la région cervicale droite, laquelle s'est avérée être un anévrisme de l'artère sous-clavière droite. Nous décrivons ici l'observation de ce patient et nous faisons la revue de la littérature sur cette pathologie assez inusitée.

Observation

Il s'agit d'un patient de 70 ans qui 10 jours avant son hospitalisation nota l'apparition d'une masse douloureuse à la région cervicale droite associée à une claudication intermittente du membre supérieur droit. D'autre part, ce malade était hypertendu depuis 13 ans mais ne présentait aucune autre manifestation clinique d'athérosclérose.

A l'examen objectif, l'état général était excellent; la tension artérielle se chiffrait à 210/110 mm Hg; l'on palpait facilement une masse pulsatile située dans le triangle cervical antérieur droit. De plus, on notait des souffles fémoraux bilatéraux ainsi qu'un souffle à la région épigastrique. Le reste de l'examen était sans particularité.

Le bilan biologique du patient s'est avéré dans les limites de la normale. L'artériographie sélective du tronc brachiocéphalique démontra la présence d'un volumineux anévrisme de la sous-clavière droite mesurant environ 6 cm de diamètre, originant à 3 cm du tronc brachiocéphalique et se terminant à l'origine de l'artère axillaire (Fig. 1). En raison de l'augmentation rapide de la masse et des dangers de thrombose ou de rupture, nous avons décidé d'en pratiquer l'exérèse.

La technique chirurgicale employée ici a consisté en une sternotomie partielle avec extension dans le troisième espace intercostal et dans la région sus-claviculaire droite (Fig. 2). L'approche s'est faite selon les principes usuels de la chirurgie artérielle et la reconstruction a été pratiquée avec une prothèse synthétique de type "Weavenit" de 10 mm. L'évolution post-opératoire fut sans particularité si l'on excepte une pneumonie du lobe inférieur droit qui a bien répondu à la thérapie conventionnelle.

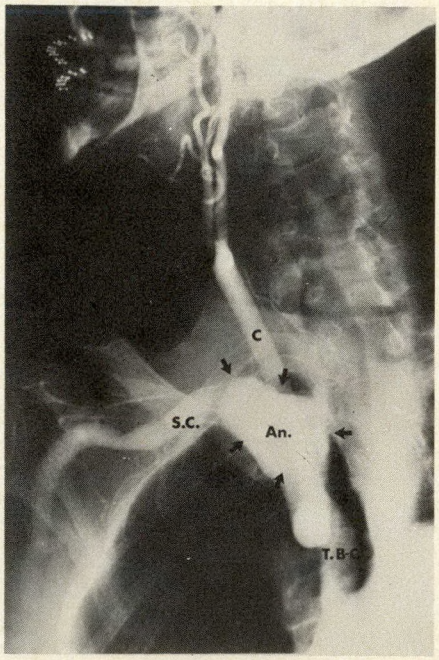


FIG. 1—L'anévrisme (An.) de la sous-clavière (S.C.) à son point de départ du tronc brachiocéphalique (T.B-C). C = carotide primitive droite.

Discussion

L'anévrisme athérosclérotique de l'artère sous-clavière est une entité pathologique extrêmement rare.[1] L'anévrisme secondaire à une compression de l'artère sous-clavière dans le défilé thoracique, ou celui secondaire à un traumatisme de la région sont beaucoup plus fréquents.[2] Dans la littérature, nous retrouvons quelques descriptions d'anévrismes d'artères sous-clavières aberrantes lesquels semblent relativement plus fréquents.[3-5] Cependant, l'incidence totale des anévrismes de l'artère sous-clavière demeure très faible si l'on tient compte du peu de cas publiés jusqu'à maintenant. Les caractéristiques cliniques des patients porteurs d'un anévrisme athérosclérotique sont: l'âge souvent avancé et les signes généraux d'athérosclérose: hypertension artérielle, infarctus ancien, anomalies électrocardiographiques, claudication intermittente, troubles cérébrovasculaires, etc. Ces caractéristiques se superposent en tout point à celles que l'on rencontre dans les autres anévrismes de type athérosclérotique (aorte abdominale, fémoral, poplité). Les anévrismes des artères périphériques sont souvent asymptomatiques et découverts lors de l'examen physique.[6] En d'autres cas, c'est le pa-

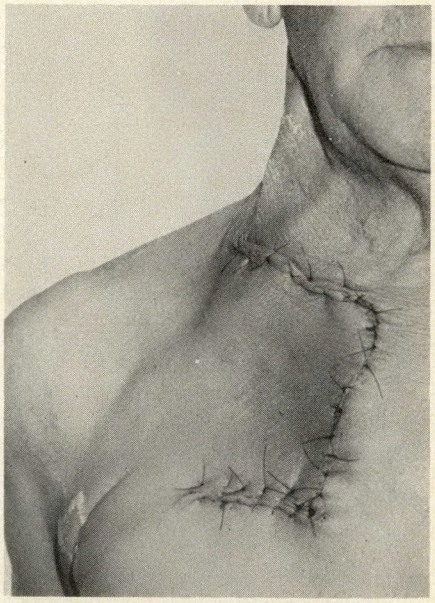


FIG. 2—L'incision du sternum se prolongeant dans le troisième espace intercostal droit et en sus-claviculaire.

*Résident, chirurgie générale, Université de Montréal, Montréal, PQ

†Chirurgien, Hôpital Maisonneuve-Rosemont, Montréal

‡Chef, département de chirurgie, Hôpital Maisonneuve-Rosemont

Les demandes de tirés à part doivent être adressées au Dr Jean Lassonde, Département de chirurgie, Hôpital Maisonneuve-Rosemont, 5415 boul. l'Assomption, Montréal, PQ H1T 2M4

tient qui note l'apparition d'une masse pulsatile comme pour le patient ci-haut mentionné. Quelquefois, ces anévrismes se manifestent par de la douleur dans les régions concernées ou par des symptômes d'insuffisance artérielle. Le diagnostic se fait habituellement à l'examen clinique et est confirmé par l'artériographie et autres moyens d'investigation.

A cause des complications toujours possibles comme la compression, la thrombose, l'embolie, la rupture, tout anévrisme devrait être traité chirurgicalement à moins d'une condition médicale contre-indiquant l'intervention. L'approche chirurgicale de l'artère sous-clavière représente un vif intérêt en raison de l'anatomie locale. Parmi les multiples techniques décrites pour absorber les vaisseaux de la base,[7,8] nous avons trouvé que la sternotomie médiane partielle avec extension cervicale et intercostale constituait une voie d'approche idéale procurant une exposition facile du tronc brachiocéphalique et de l'origine de l'artère sous-clavière.[9] De plus, cette approche permet l'adjonction d'incision cervicale ou thoracique. La sécurité obtenue par un contrôle facile des vaisseaux de la base et le peu de morbidité associée nous porte à recommander ce type d'incision pour toute approche des vaisseaux de la base du cou à droite. Il faut, de plus, noter que la clavicule peut être réséquée sans hésitation si le besoin s'en fait sentir. Après la résection de l'anévrisme, il est préférable de rétablir la continuité vasculaire avec une prothèse synthétique adéquate,[6] bien que l'on pourrait théoriquement recourir à la simple ligature de l'artère sous-clavière sans grand danger pour la vascularisation du membre, vu la circulation collatérale abondante à ce niveau. Le rétablissement de la continuité est cependant préférable.

Bibliographie

1. Chiavacci WE, Bucciarelli RL, Victorica BF: Aneurysm of the subclavian artery: a complication of retrograde brachial artery catheterisation. *Cathet Cardiovasc Diagn* 2: 93, 1976
2. Sturm JT, Strate RG, Mowlem A, et al: Blunt trauma to the subclavian artery. *Surg Gynecol Obstet* 138: 915, 1973
3. Engelman RM, Madayag ML: Aberrant right subclavian artery aneurysm: a rare cause of a superior mediastinal tumor. *Chest* 62: 45, 1972
4. Hunter JA, Dye WS, Javid H, et al: Arteriosclerotic aneurysm of anomalous right subclavian artery. *J Thorac Cardiovasc Surg* 59: 754, 1970
5. McCallen AM, Schaff B: Aneurysm of anomalous right subclavian artery. *Radiology* 66: 561, 1956
6. Howell JF, Crawford ES, Morris GC jr, et al: Surgical treatment of peripheral arteriosclerotic aneurysm. *Surg Clin North Am* 46: 979, 1966
7. Hunt TK, Blaisdell FW, Okimoto J: Vascular injuries of the base of the neck. *Arch Surg* 98: 586, 1969
8. Shumacker HB jr: Operative exposure of the blood vessels in the superior anterior mediastinum. *Ann Surg* 127: 464, 1948
9. Moloney GE: Excision of an aneurysm of the right subclavian artery; case history and discussion. *Br J Surg* 43: 94, 1955

Directives aux contribuants

Toute communication initiale doit être adressée aux corédacteurs, CP 8650, Ottawa, Ont. K1G 0G8 sous la mention: "Le journal canadien de chirurgie".

Les textes originaux des articles et des autres communications y compris un nombre limité de rapports sur des cas spéciaux doivent être rédigés en double exemplaire, en français ou anglais, et accompagnés d'une lettre demandant leur publication dans le Journal. Veuillez les dactylographier sur une seule face d'une feuille non réglée avec double interligne et grandes marges.

Les illustrations telles que des photographies d'appareils cliniques, des radiographies, des photomicrographies, des graphiques et des diagrammes doivent être fournies sous la forme d'épreuves sur papier glacé sans montage, les bordures intactes, d'un format ne dépassant pas 12 x 17 cm. Chaque illustration doit être munie d'une légende dactylographiée sur une page séparée du texte de l'article. S'il s'agit d'une photomicrographie, indiquez le contraste et l'échelle de l'agrandissement. Les lettres qui servent à identifier les éléments d'une illustration doivent être d'une dimension suffisante afin de demeurer visibles lorsque les nécessités de l'impression imposent une réduction de l'image fournie.

Il ne faut pas qu'on puisse identifier un patient grâce à une illustration à moins qu'il n'y ait expressément consenti par écrit; faute de permission les traits de sa physionomie doivent être oblitérés.

Les illustrations en couleur ne seront publiées qu'aux frais de l'auteur. Si l'illustration provient d'une autre source, il convient d'obtenir tant de l'auteur que de l'éditeur de l'ouvrage dont elle est tirée, l'autorisation de s'en servir aux fins de la publication.

Il faut que les tableaux se conforment au format rectangulaire du Journal et les rédiger sur des feuilles séparées du texte, un tableau par feuille.

Les références *doivent être citées dans le texte au moyen d'un chiffre et groupées dans l'ordre à la fin de l'article en se conformant à la manière de faire adoptée par ce Journal. Les références à des périodiques doivent être conformes à celles qu'adopte* l'Index Medicus.

Un résumé *qui ne doit pas dépasser 125 mots doit accompagner chaque article sur une feuille séparée.*

A titre d'approbation, un exemplaire du manuscrit rédigé sera envoyé à l'auteur mais non les épreuves.

DAVIS & GECK SURGICAL ESSAY AWARD FOR RESIDENTS

Davis & Geck annually awards $1000.00 to the surgical resident submitting the best paper on a surgical topic to the *Canadian Journal of Surgery*. This award is intended to promote scientific and literary excellence among Canadian surgeons in training.

The conditions of entry for the 1978 award are the following:

1. Candidates shall be currently engaged in a recognized surgical residency program leading to eligibility for the Fellowship of the Royal College of Physicians and Surgeons of Canada in one of the surgical specialties (cardiovascular and thoracic surgery, general surgery, neurosurgery, obstetrics and gynecology, ophthalmology, otolaryngology, orthopedic surgery, plastic surgery and urology).
2. The material to be submitted shall be in the form of a manuscript relating to work in which a surgical resident is or has been the prime or major investigator. Prior oral presentation at a Royal College meeting or a surgical forum meeting will not be a disqualification, but prior publication as a formal paper in a journal will. The paper should relate to any field of surgical interest. The manuscript must conform to the style requirements of the Journal and must not exceed 3000 words of text and six tables and/or six figures. Coauthors are permitted on the understanding that the candidate shall be the first author and that only the first author shall be eligible for the award.
3. Entries must be received in the office of the Journal no later than June 30, 1978. Each entry must be submitted to the editorial office of the *Canadian Journal of Surgery*, PO Box 8650, Ottawa, Ont. K1G 0G8, with a letter stating that the paper is being submitted as an entry for the Davis & Geck Surgical Essay Award.
4. All papers submitted shall be the property of the *Canadian Journal of Surgery* unless returned to the author without publication.

All papers submitted will be judged by an independent committee comprising at least one member of the editorial board of the Journal, one fellow of the Royal College of Physicians and Surgeons of Canada, and one representative of The Canadian Medical Association, together with other fellows invited to serve at the discretion of the three permanent members of the committee. For the purpose of judging, the candidates will be anonymous. The judges' decision shall be final.

The name of the successful candidate and the title of the paper will be announced in the November 1978 issue of the Journal.

BOOK REVIEWS

THE ACUTE ABDOMEN. An Approach to Diagnosis and Management. 2nd ed. Thomas W. Bosford and Richard E. Wilson. 325 pp. Illust. W.B. Saunders Company Canada Limited, Toronto, 1977. $8.75, paperbound. ISBN 0-7216-1886-3

This book is a revised version of the first edition published in 1961. In the preface to that edition the authors stressed an organized clinical approach to the patient with the acute abdomen, emphasizing the basic pathologic processes rather than the list of organs that may be involved. This sound policy has been continued, with discussion of newer investigative methods and the increased use of abdominal diagrams to serve as a visual summary of the many important points.

Section I, entitled "The Tools", includes chapters on clinical approach, laboratory aids, roentgenography, ultrasonography, arteriography and anesthesia. In addition, pitfalls in diagnosis of the acute abdomen are described. The time-honoured basics of examination receive justly more emphasis than the more specialized facets, thus emphasizing the proper perspective for thorough clinical assessment. Numerous roentgenograms and schematic drawings provide a clear picture of the complete variety of conditions discussed.

Section II has two chapters on abdominal trauma; the authors have outlined a general approach to the diagnosis and management of specific injuries. This again presents details that parallel the clinical appearance of these conditions.

Section III deals with acute abdominal inflammatory disease and is divided into abdominal lesions that may perforate, nonperforative acute upper abdominal lesions and nonperforative acute lower abdominal lesions. This is a well-written section. The more common lesions are described; these descriptions are supplemented by assessment of the rarer diseases that may simulate an acute surgical abdomen.

The authors describe intestinal obstruction and hemorrhage in separate sections. The topics are divided into upper and lower bowel obstruction and intraluminal and extraluminal gastrointestinal hemorrhage. By this systematic approach the authors provide a clinical setting and approach to emphasize the important aspects of these conditions. The postoperative management of the abdomen is thoroughly discussed in the final chapter.

This is a pocket-sized book which can be carried about easily and used on the spot in hospital emergency rooms or offices. The authors have supplied a conceptual framework within which the physician can map a course of action. The nine-page index is suitably headed to facilitate on-the-job use.

I believe that this book can be strongly recommended for use by all who have any responsibility for the diagnosis and treatment of the acute abdomen. The authors' approach is clinical; they stress the investigative procedures that are practical. The value of such investigations is always considered supplementary to the history and examination of the patient.

T. KEITH SCOBIE
Department of surgery,
Ottawa Civic Hospital,
Ottawa, Ont.

ADVANCES IN SURGERY. Vol. 10. Edited by William P. Longmire, Jr. 330 pp. Illust. Year Book Medical Publishers, Inc., Chicago, 1976. Price not stated. ISBN 0-8151-5632-4

This text has again accomplished the objective of identifying and reviewing advances in surgical knowledge.

The first chapter on electrocardiography is succinct and applicable to all surgical disciplines. The concept that the general surgeon should be knowledgeable in simple electrocardiography, signals a desirable change in surgical teaching. All surgeons who manage patients with acute disease should be able to recognize arrythmias, ischemic patterns and patterns consistent with pulmonary embolization; a study of this portion of the book would accomplish that purpose.

The second chapter on the endocrine system is excellent and should be obligatory reading for residents and general surgeons. Included is an adequate historical review and a description of the embryologic development of the neuroendocrine system. The physiology and pathology are described and the authors have included a description of the clinical syndromes involving the endocrine system; special reference is made to those related to the ectopic production of hormones.

The symposium on gallstones has an especially interesting review of etiology and pathogenesis. The current status of the systemic treatment of gallstones is reviewed; one can only conclude that the general surgeon's workload in biliary tract surgery is not yet threatened. The dissolution of retained common-duct stones is of historical interest only but it is complete. The nonoperative extraction of common-duct stones is described in detail. This procedure is the most recent addition to the repertoire of the surgeon who deals with biliary tract problems. It is a useful technique that will contribute to lower morbidity; unfortunately it occasionally carries with it serious complications. The availability of this procedure should not make the surgeon complacent about leaving a stone in the common bile duct.

The review of tumours of the islands of Langerhans is complete and detailed; much of the material is repetitious of the chapter on the endocrine system. The contributions of the author, Dr. R.M. Jolinger, are put into perspective. The new glucagonoma syndrome and other syndromes associated with tumours or hyperplasia of the islands of Langerhans are described.

Although uncommon in most surgical practices, benign esophageal stricture remains a serious problem and the authors have therefore properly included a chapter containing a good description of the etiology and management. The operative techniques for Collis gastroplasty, Thal patch and Nissen plication are adequately described and the authors have also explained colon and gastric tube interposition procedures. As the numbers are small, no attempt is made to compare the results of the various techniques.

The final chapter is a brief review of currently available breast cancer detection procedures including mammography, xeromammography, chemography and sonography. The author describes the screening procedures available and attempts to put into perspective the logistics and feasibility of breast screening. It is clear that thermography and sonography are of limited use in the detection of breast cancer.

A.R. DOWNS
Professor and head,
Department of surgery,
University of Manitoba,
Winnipeg, Man.

ARTHRITIS SURGERY. Leonard Marmor. 548 pp. Illust. Lea & Febiger, Philadelphia; The Macmillan Company of Canada Limited, Toronto, 1976. $54.30. ISBN 0-8121-0537-0

Contained within this single book is an excellent detailed description of practically every operative procedure for treating the arthritic patient. Each chapter describes the arthritic involvement of an anatomical region, including the gross anatomy, physical examination and methods of treatment. Each chapter in turn is divided into the problems of the patient with rheumatoid or osteoarthritis. Two final chapters refer to the specific problems of juvenile rheumatoid arthritis and fracture management in arthritic patients. The total content encompasses a reasonable survey of the current status of surgery for patients with arthritis.

The author is a noted orthopedic surgeon who brings a vast personal experience in all aspects of arthritic surgery to this book. Because of his experience, the details described are pertinent and extensive; details include the preferred drug and the relative costing. The surgeon will appreciate particularly the author's detailed descriptions of the pre- and postoperative management, techniques and pitfalls.

The book is well illustrated; many of the anatomical drawings are taken from "Gray's Anatomy". An extensive reference list is included with each chapter.

The chapters on the knee and hip joints contain a brief history of the development of prosthetic joints. The author puts too much emphasis on the value of the knee prosthesis that he designed; this is a major criticism of the book. People in the field will be aware of the numerous prosthetic devices and their inherent problems. Readers are also aware of the numerous efforts to design better artificial joints. At the present stage of development, however, it is difficult for the reader to match the enthusiasm of the author for the Marmor modular knee system.

The practising orthopedic surgeon will rely on texts such as this because of the considerable advances and changes occurring in arthritis surgery during each decade. The orthopedic trainee would do well to peruse at least the anatomical descriptions and the operative techniques described in this book. The essential message for us all from this author is clear. We are told what not to expect from certain reconstructive procedures.

JAMES J. WILEY
Orthopedic surgeon,
Ottawa General Hospital,
Ottawa, Ont.

BREAST CANCER. Edited from the Proceedings of the International Breast Cancer Conference held in Lucerne, Switzerland, July 31st-August 4th, 1976. Edited by Albert C.W. Montague, Geary L. Stone and Edward F. Lewison. 549 pp. Illust. Alan R. Liss, Inc., New York, 1977. $38. ISBN 0-8451-0012-2

As the title suggests, this book comprises papers presented at the International Breast Cancer Conference held in Lucerne, Switzerland in 1976. The chapters included are on epidemiology, biology, hormonal influences, clinical detection and screening, roentgenographic and thermographic diagnosis, treatment of the primary lesion, adjuvant therapy, treatment of metastatic disease, bilateral breast cancer and rehabilitation. Each chapter consists of from two to nine papers with occasional duplication but also differing points of view. Most of the authors are well-known authorities from the United States; the remaining authors are chiefly Swiss, but a few are from other countries such as Great Britain and Italy, and three are Canadians — A.G. Fagekas, J.K. MacFarlane and L.J. Mahoney.

The treatises will be highly attractive to clinicians with a special interest in breast cancer although many of the presentations have been published earlier and add nothing to the original publication. The student will find standard textbooks more relevant to their needs because of the uneven coverage that is to be expected in such a symposium. Pathology, for instance, is not covered.

A minor irritation is the photostatic reproduction of the submitted manuscripts. As a result, the type varies in kind and size, and hand-written corrections of some of the typographical errors are included. The book presents succinctly the state of the art in 1976 of the topics covered.

J.E. DEVITT
Associate dean,
Continuing medical education,
University of Ottawa,
Ottawa, Ont.

CHIRURGIE PLASTIQUE CUTANÉE DE LA MAIN ET DE LA PULPE, 2e éd. R. Vilain et J. Michon. 162 pp. Illust. Masson, Paris, 1977. $26. ISBN 2-225-45122-2

The main emphasis of this text is on the anatomy, physiology and treatment of trauma as it applies to the specialized skin of the hand. The book is not a compendium of hand surgery and there is little discussion of congenital anomalies, skeletal injury, nerve and tendon trauma, or complex reconstructive procedures.

The introductory chapters review basic concepts of wound healing, techniques of hand surgery, incisions and applied anatomy. The book is well illustrated with photographs and excellent line drawings.

The authors include descriptions of ingenious methods by which local flaps may be used to resurface the hand; some of these were pioneered by the authors. In addition, the book includes several examples of the versatility of the flag flap and discussions on the standard distant flaps, the classic cross-finger, thenar and cross-arm flaps.

The problems involved in resurfacing mangling injuries of the volar and dorsal aspects of the hand are outlined; unfortunately the detailed section on fingertip injuries does not include a description of the Kleinert flap. The most detailed and original material is in the chapter on injuries of the nail and nail bed.

The bibliography ends with 1974 references and largely reflects pre-1974 contributions. Thus, newer practical concepts such as the groin flap, the deltopectoral flap, principles of free flaps, microvascular surgery and finger degloving injuries are not reviewed in this volume.

The text is wordy. Since most of the material is well covered in standard English texts of hand surgery, it is unlikely that it will be translated into English.

PAUL R. BENOIT
Ste. 104,
340 McLeod St.,
Ottawa, Ont.

CLINICAL MICRONEUROSURGERY. Edited by W. Th. Koos, F.W. Böck and F.R. Spetzler, 317 pp. Illust. Georg Thieme Verlag Publishers, Stuttgart; Publishing Sciences Group, Inc., Acton, 1976. $41.50. ISBN 3-13-523601-3

Sixteen years ago, in the pages of this journal, Lougheed and Tom (*Can J Surg* 4: 329, 1961) first recorded the use of the operating microscope in surgery of the nervous system. Since then, the microscope has become essential to the safe and accurate performance of many neurosurgical procedures. It is now almost unthinkable to clip a cerebral aneurysm, remove an acoustic or pituitary tumour, or even suture a peripheral nerve, without the clarity of exposure, magnification and illumination provided by a microscope.

Contemporary neurosurgical literature is replete with microsurgical information ranging from elegant coloured microanatomical displays to technical details and results of microneurosurgical procedures. Therefore, a reader should have high expectations from a book entitled "Clinical Microneurosurgery", which is intended to "serve as a thorough reference work on the state of modern microsurgery." Unfortunately, the reader will probably be disappointed.

The book is an update based on contributions to the International Congress on Microsurgery, held in Vienna in October 1972. Most of the contributors are European, although a few are North American or Japanese. The translation into English is adequate. The black and white illustrations and photographs are, for the most part, quite clear.

The book provides a matrix into which the large experience of the University of Vienna neurosurgical department is woven. The chapter on the microanatomy of the cerebellopontine angle provides a clear review of the relations of the lower cranial nerves and tiny blood vessels. Koos, Böck and Spetzler review 60 angle tumours, 90% of which were of very large size; the mortality rate was 3% in patients with large tumours and 8% in patients with very large tumours. These authors describe a standard posterior fossa approach in well-illustrated step-by-step detail. They recommend, but do not describe, prior translabyrinthine removal of the intracanalicular portion of large tumours by an otolaryngologist.

Koos and his colleagues also reported 320 patients with sellar lesions. Most of the pituitary adenomas were removed by a transcranial subfrontal approach. Although numerous black and white photographs taken through the operating microscope illustrate the paper, there are no step-by-step descriptions of the technique used and no breakdown of the results. In their paper on 32 craniopharyngiomas, the authors state that even with the help of the operating microscope total tumour removal is usually impossible; two thirds of the patients thought to have had a total removal, developed late recurrences. The book also contains papers on the transethmoidal approach, and the transfrontal transsphenoidal approach to the sella.

The section on microsurgery of vascular lesions is very brief. There are papers that have little connection with microsurgery. These include, for example, the effects of subarachnoid hemorrhage on cerebral blood flow, percutaneous trigeminal tractotomy and vestibular tests in acoustic neuromas. There is no section on instrumentation or technique, and the chapter describing microscopes is unfortunately quite out of date.

To those already doing microneurosurgery, the book offers little that is new. To those entering the field, the book is insufficient to be of much value. It is the sixth book on microneurosurgery in this reviewer's library. A comprehensive text on the subject has yet to appear. One

awaits with interest the appearance in December 1977 of the second edition of Rand's book on microneurosurgery.

Ross Fleming
Division of neurosurgery,
Toronto Western Hospital,
Toronto, Ont.

CURRENT MANAGEMENT OF ACUTE GASTROINTESTINAL HEMORRHAGE. Edited by Teruo Matsumoto. 256 pp. Illust. Charles C Thomas, Publisher, Springfield, IL, 1977. $19.75. ISBN 0-398-03582-2

The editor has included in this book a wide range of clinical entities. He presents excellent material on pathogenesis with particular reference to upper gastrointestinal hemorrhage. Sections on stress ulcer, gastritis and duodenal ulcer are also well done.

The very little information included regarding the technical aspects of surgical management can be considered a strength rather than a weakness in a book of this size.

Diagnostic aids are dealt with reasonably well. The roentgenograms are excellent and demonstrate lesions clearly. The chapter on arteriography is not well balanced. There is too much technical detail and no mention is made of the use of arteriography in the management of small bowel and colonic hemorrhage; this is its most common application in our institution.

Time spent in several chapters on the management of hypovolemic shock is not appropriate and often is inaccurate. For example, we disagree with the belief that packed cells and fresh-frozen plasma is preferable to whole blood in treating hemorrhagic shock. Space occupied by this material could have been devoted to a more detailed description of the surgical management of lower gastrointestinal hemorrhage. This section is weak.

The editor has succeeded in presenting for our consideration a knowledge base for medical students and primary care physicians. Most of the information is accurate and well presented.

John R. Gutelius
Department of surgery,
Queen's University,
Kingston, Ont.

SPECIAL TUMORS OF OVARY AND TESTIS AND RELATED EXTRAGONODAL LESIONS. Comparative Pathology and Histological Identification. 2nd ed. Gunnar Teilum. 513 pp. Illust. Munksgaard International Publishers Ltd.. Copenhagen; J.B. Lippincott Company of Canada, Toronto, 1976. $59.50. ISBN 0-397-58197-1

This is an interesting, well-illustrated and well-referenced text by an authority who has published a great deal in the fields he covers. The content of this book extends beyond that suggested by the title. In a conventional text the author might systematically cover all tumours of a system or organ. In this text the author describes only certain tumours of both the male and female genital organs including those of germ cell origin and gonadal stroma, clear cell tumours and mesonephric adenocarcinomas; the various malignant and benign lesions associated with intersex are also described. Teilum includes a description of the embryologic development of ovary and testis and follows this up with an explanation of the comparative pathology of ovarian and testicular tumours. Related extragonadal lesions are also included in this discussion.

In the second part of the book Teilum concerns himself with histologic identification; for each tumour mentioned, synonyms are listed and a definition and historical perspective are included. Where indicated the author describes the histogenesis, gross appearances, histology and differential diagnosis.

The book is large, but the arrangement is not cramped; reading it is therefore not a chore. The content is well organized and pertinent. The information is similar to that found in other texts of gynecologic pathology, but the author's comments based on extensive personal experience give this text a special benefit. The illustrations are all in black and white, either full or half-page; the detail and the related text are clear and to the point. This book is an excellent reference text for the routine and comparative pathology of the particular gonadal tumours included and would be of interest to pathologists and gynecologists concerned with oncology.

H.D. Steele
Department of pathology,
Kingston General Hospital,
Kingston, Ont.

TRAITÉ DE TECHNIQUE CHIRURGICALE O.R.L. ET CERVICO-FACIALE. Tome HI. Pharynx et Larynx. Yves Guerrier. 502 pp. Illust. Masson, Paris, 1977. $121. ISBN 2-225-45420-5

Bien qu'il s'agisse avant tout d'un livre de technique chirurgicale, on n'a pas négligé pour autant les indications de chacune des techniques, la préparation du malade à l'intervention, les soins postopératoires souvent très difficiles, le traitement des complications éventuelles, les associations radiochirurgicales ainsi que les traitements médicaux d'appoint en cancérologie. On y traite aussi des temps de reconstruction plastique dans la chirurgie réparatrice du pharynx et du larynx.

Cet ouvrage est divisé en 10 grand chapitres: le premier est consacré à la chirurgie pharyngée per-orale, le second concerne la chirurgie du fibrome naso-pharyngien et les 8 autres chapitres, la chirurgie majeure par voie cervicale.

Ce tome concerne exclusivement le pharynx et le larynx. Il fait partie d'un ensemble de quatres tomes dont le premier sur l'oreille et l'os temporal, et le deuxième sur le nez et la face ont été rédigés sous la direction du professeur Michel Portmann. Les tomes 3 et 4 le sont sous celle du professeur Yves Guerrier. Le tome 4 traitera de la cavité buccale et du cou.

Il n'y a aucun doute que ce volume, tout comme les deux premiers tomes, rendra grand service non seulement aux étudiants en otorhinolaryngologie, mais à tous ceux qui sont intéressés à la cancérologie de ces régions.

Le prix de ce volume peut paraître excessif (au-delà de $100.), mais ce coût n'en n'est pas moins très justifié par la masse des connaissances qu'il apporte et l'abondance de ses illustrations.

Le professeur Guerrier et ses collaborateurs ont dépassé largement le strict point de vue technique, et on voit tout au long de la lecture de ce volume, que l'otorhinolaryngologiste doit traiter non seulement une maladie mais aussi un malade.

P. Fugère
Directeur du département d'ORL,
Université Laval,
Québec, PQ